SAINT PAUL FOUNDRY CO.

SAINT PAUL, MINNESOTA

1910

THE LIBRARIES

COLUMBIA UNIVERSITY

AVERY LIBRARY

Ford

James J. Dewitt.
982 Mound Ave.
St. Paul
Minn.

SHOPS OF ST. PAUL FOUNDRY CO.

COMO AVE. AND MACKUBIN ST. 1909 ST. PAUL, MINN.

Digitized by the Internet Archive
in 2020 with funding from
Columbia University Libraries

https://archive.org/details/handbookcontaini00sain

A HAND-BOOK

CONTAINING USEFUL INFORMATION AND TABLES
APPERTAINING TO THE USE OF

STRUCTURAL STEEL
AND
CAST IRON

FOR ENGINEERS, ARCHITECTS AND
BUILDERS

ST. PAUL FOUNDRY CO.
STRUCTURAL ENGINEERS, FOUNDERS, MACHINISTS
COMO AVE. AND MACKUBIN ST.
ST. PAUL, MINN.

Established 1883

ENTERED ACCORDING TO ACT OF CONGRESS
IN THE YEAR 1909 BY THE
ST. PAUL FOUNDRY CO.
IN THE
OFFICE OF THE LIBRARIAN OF CONGRESS
AT WASHINGTON, D. C.

PRICE $1.25

Preface to Second Edition.

THE second edition of our hand-book contains most of the data included in the first edition, together with a large amount of new data.

Tables of properties of standard sections and cuts and data relating to Bethlehem sections have been added.

A number of new and specially designed patterns for column caps, newel posts, stair railings and lamp posts are shown.

All of the subject matter has been carefully revised and corrected to bring it up to date.

Compiled by H. C. Palmer.

STRUCTURAL STEEL DEPARTMENT

We now have one of the largest and best equipped structural steel shops in the Northwest, and are prepared to furnish and erect

ARCHITECTURAL STEEL WORK

PLATE AND BOX GIRDERS

COLUMNS, BEAMS, LINTELS

TRUSSES OF ALL KINDS FOR ROOFS AND FLOORS

STEEL HIGHWAY BRIDGES

PLATE GIRDER R. R. BRIDGES

R. R. TURNTABLES

WATER TOWERS AND TANKS

VIADUCTS, TRESTLES

COAL AND ORE HANDLING DEVICES

GALLOWS FRAMES FOR MINE SHAFTS

STEEL FRAME MILL BUILDINGS AND

MISCELLANEOUS STEEL WORK

We carry a stock of from 3,000 to 4,000 tons of Steel Shapes, and are prepared to execute orders on short notice.

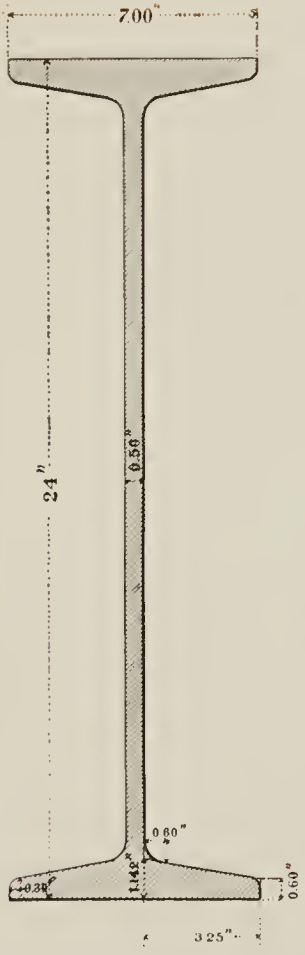
DESIGNS AND ESTIMATES ON APPLICATION

CUTS OF AMERICAN STANDARD STRUCTURAL STEEL SECTIONS

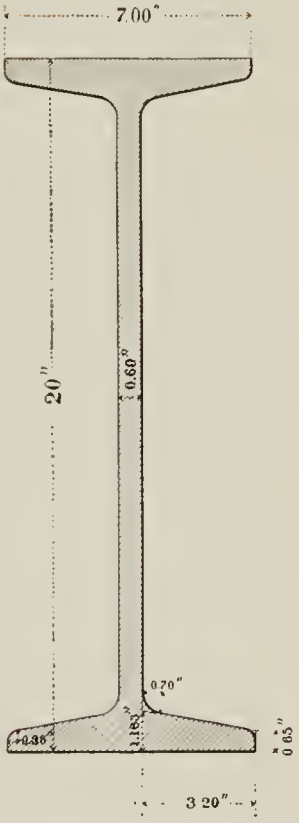
THE DIMENSIONS BELONG TO THE LIGHTEST SECTIONS

FOR DIMENSIONS OF BEAMS AND CHANNELS OF THE HEAVIER SECTIONS, SEE PAGE 22

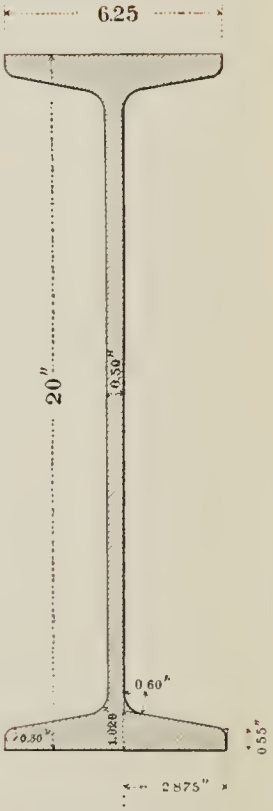
I-BEAMS



24", 80 lbs. per foot
85, 90, 95 and 100 lbs.



20", 80 lbs. per foot
85, 90, 95 and 100 lbs.

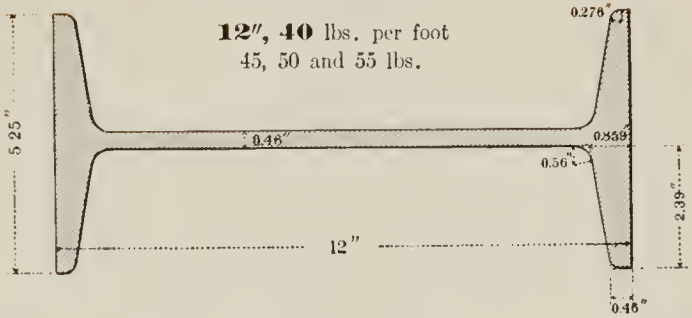


20", 65 lbs. per foot
70 and 75 lbs.

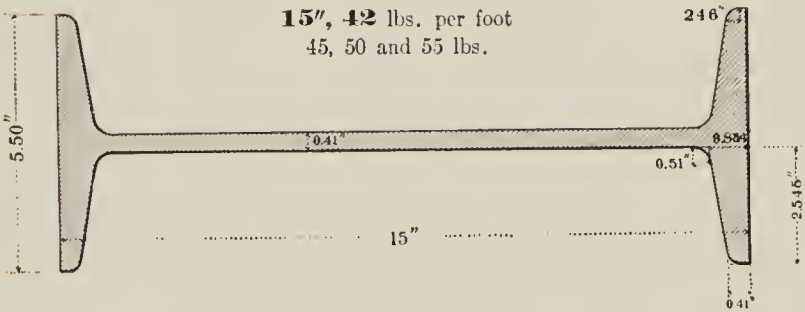
Weights in heavy type are standard; others are special.

I-BEAMS

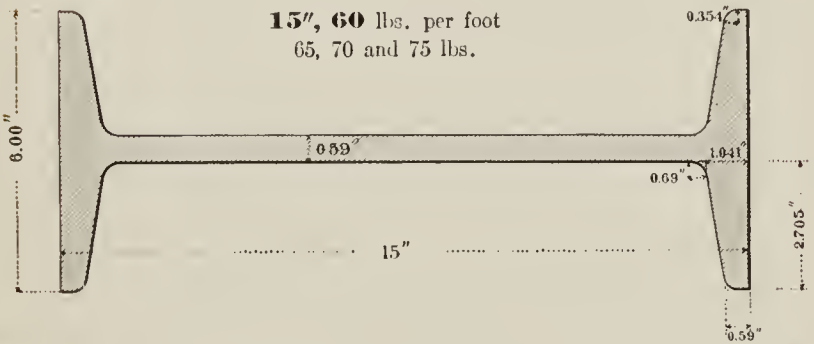
12″, 40 lbs. per foot
45, 50 and 55 lbs.



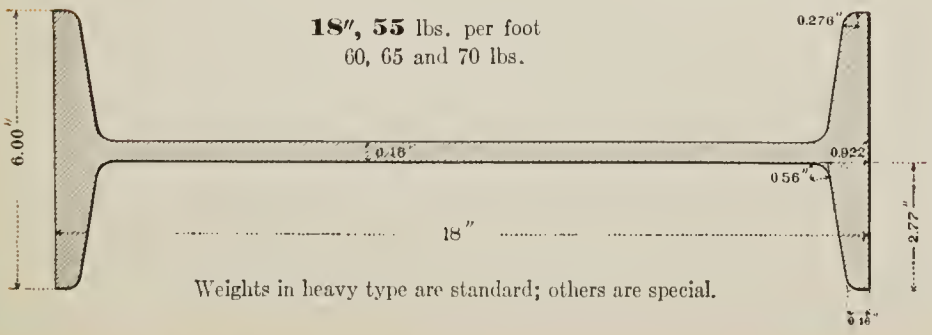
15″, 42 lbs. per foot
45, 50 and 55 lbs.



15″, 60 lbs. per foot
65, 70 and 75 lbs.

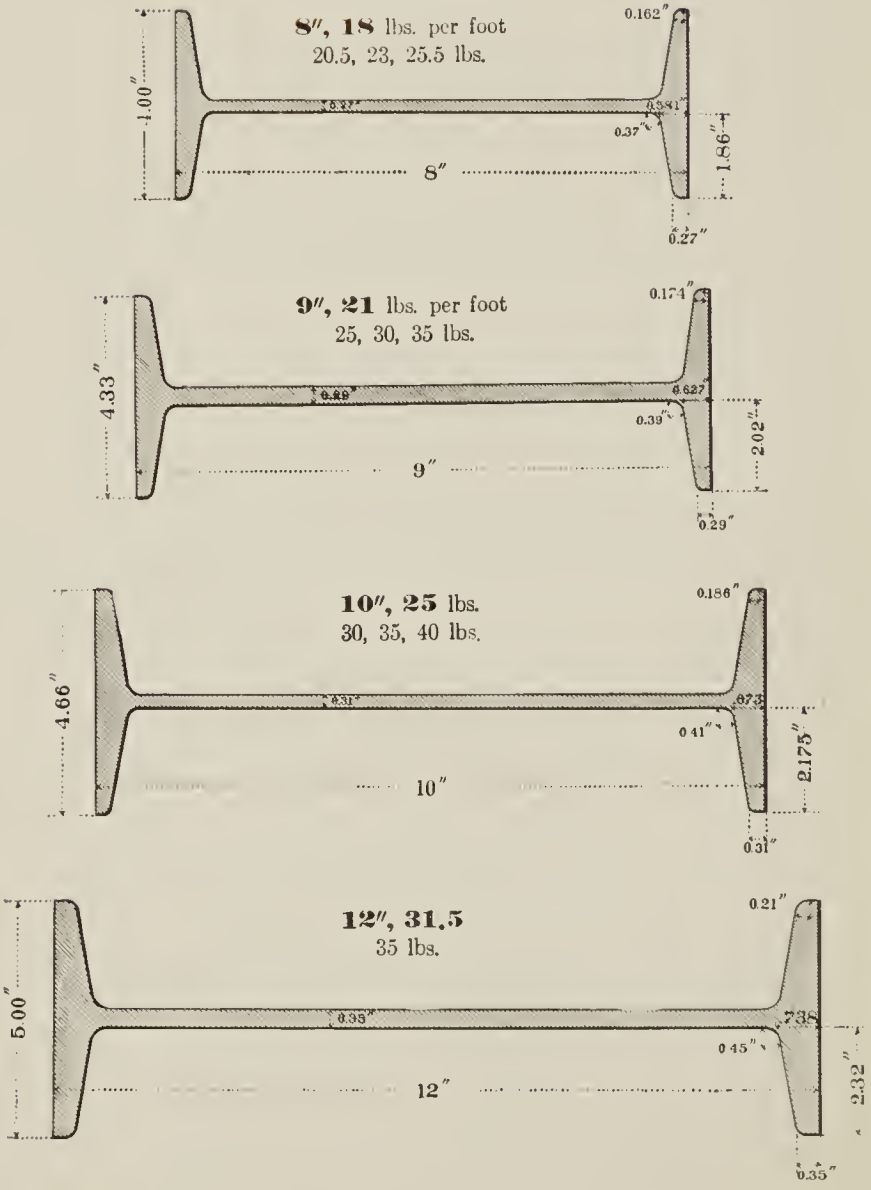


18″, 55 lbs. per foot
60, 65 and 70 lbs.



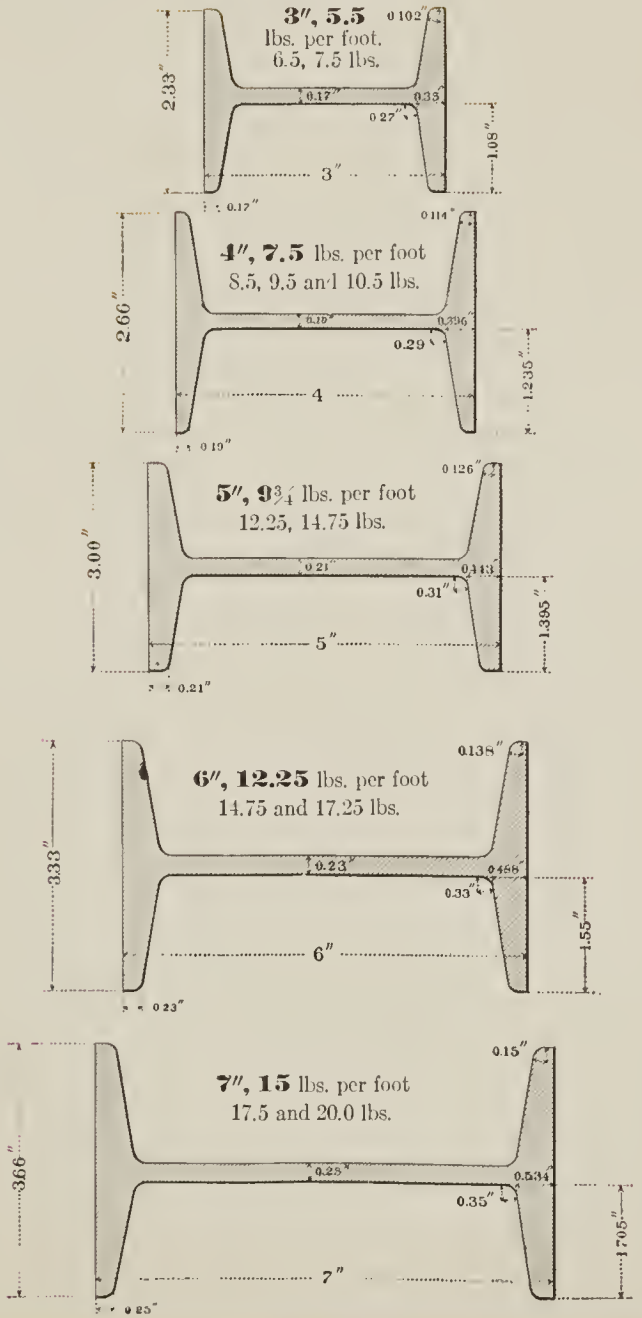
Weights in heavy type are standard; others are special.

I-BEAMS



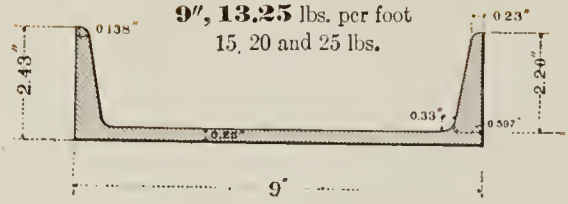
Weights in heavy type are standard; others are special.

I-BEAMS

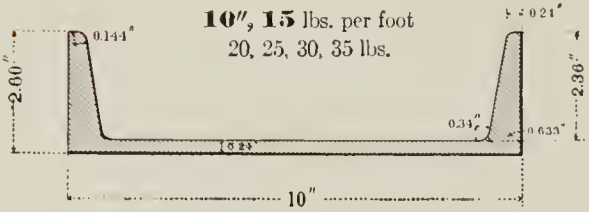


Weights in large type are standard; others are special.

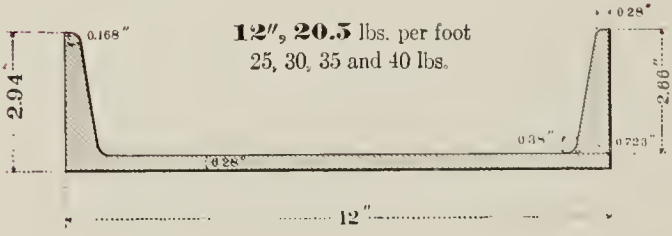
CHANNELS



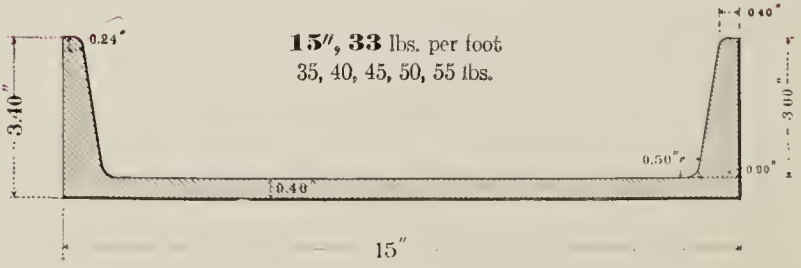
9″, 13.25 lbs. per foot
15, 20 and 25 lbs.



10″, 15 lbs. per foot
20, 25, 30, 35 lbs.



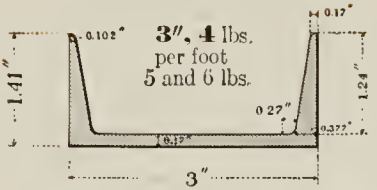
12″, 20.5 lbs. per foot
25, 30, 35 and 40 lbs.



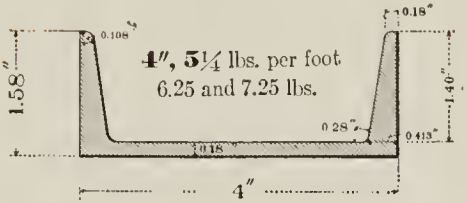
15″, 33 lbs. per foot
35, 40, 45, 50, 55 lbs.

Weights in heavy type are standard; others are special.

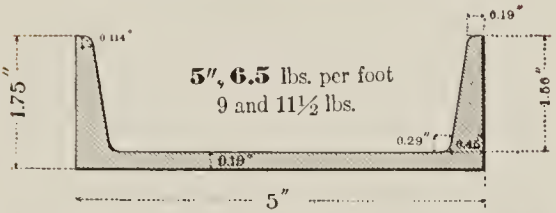
CHANNELS



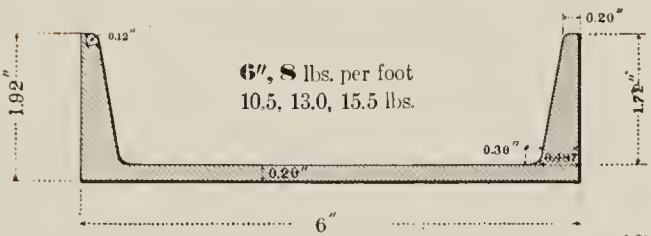
3″, 4 lbs. per foot
5 and 6 lbs.



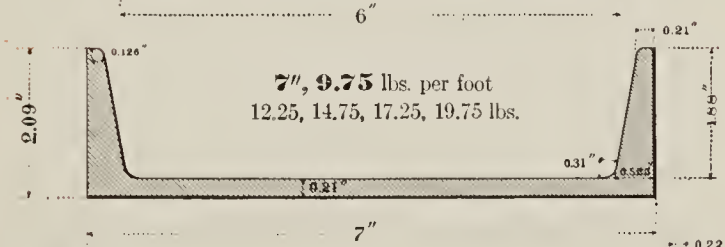
4″, 5¼ lbs. per foot
6.25 and 7.25 lbs.



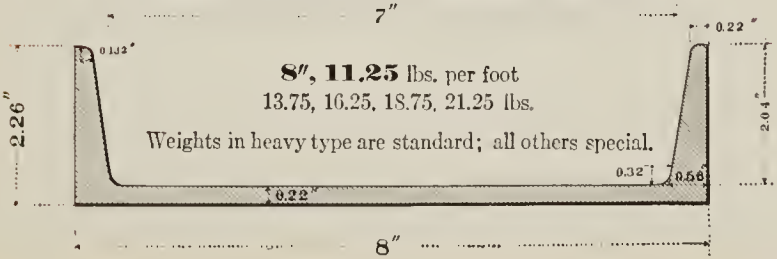
5″, 6.5 lbs. per foot
9 and 11½ lbs.



6″, 8 lbs. per foot
10.5, 13.0, 15.5 lbs.



7″, 9.75 lbs. per foot
12.25, 14.75, 17.25, 19.75 lbs.

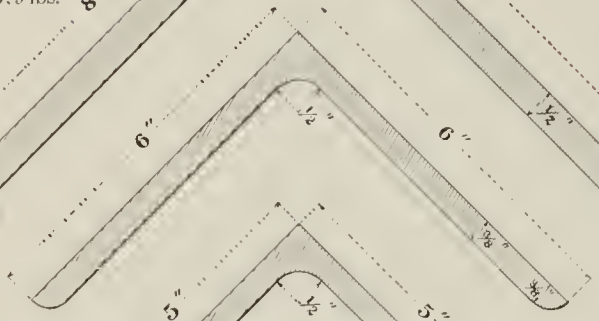


8″, 11.25 lbs. per foot
13.75, 16.25, 18.75, 21.25 lbs.

Weights in heavy type are standard; all others special.

EQUAL LEGGED ANGLES

8″ Angle
26.4 to 56.9 lbs.



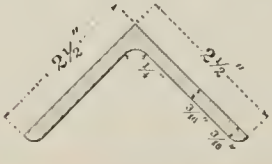
6″ Angle
14.8 to
37.4 lbs.

5″ Angle
12.3 to 30.6
lbs.

4″ Angle
8.2 to 19.9 lbs.

3½″ Angle
7.1 to 17.1 lbs.

3″ Angle
4.9 to 11.4 lbs.



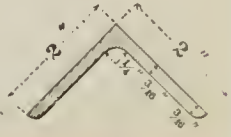
2½″ Angle
3.1 to 7.7 lbs.

¾″ Angle
0.6 to 0.8 lbs.

⅞″ Angle
0.7 to 1.0 lbs.

1″ Angle
0.8 to 1.5 lbs.

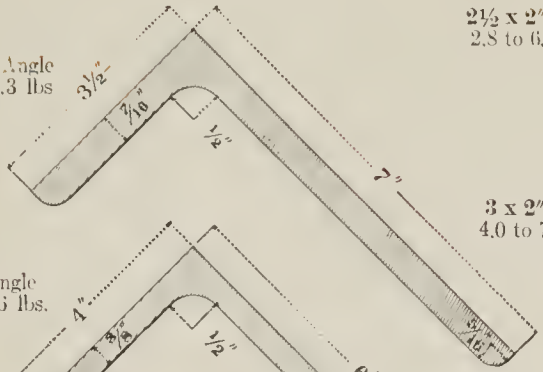
1¾″ Angle
2.1 to 4.6 lbs.



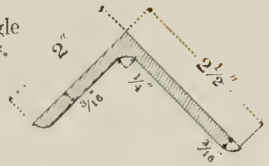
2″ Angle
2.5 to 5.3 lbs.

UNEQUAL LEGGED ANGLES

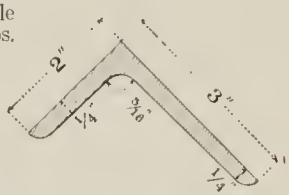
7 x 3½″ Angle
15.0 to 32.3 lbs



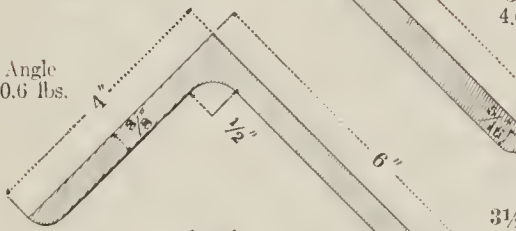
2½ x 2″ Angle
2.8 to 6.8 lbs.



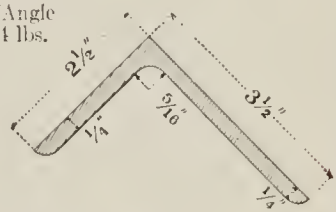
3 x 2″ Angle
4.0 to 7.7 lbs.



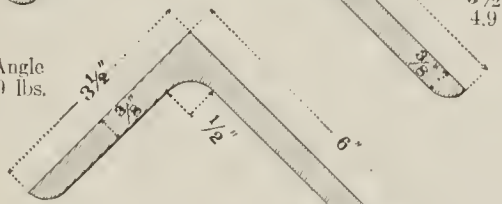
6 x 4″ Angle
12.3 to 30.6 lbs.



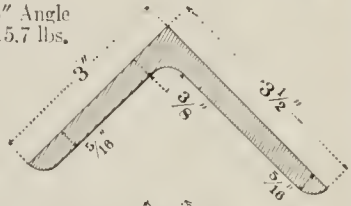
3½x2½″ Angle
4.9 to 12.4 lbs.



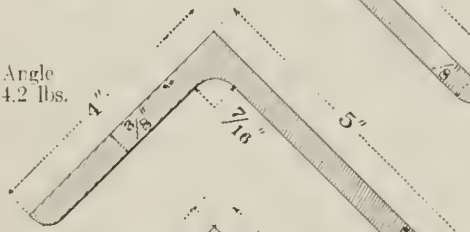
6 x 3½″ Angle
11.7 to 28.9 lbs.



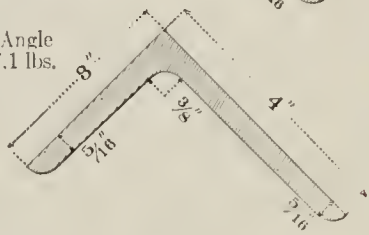
3½ x 3″ Angle
6.6 to 15.7 lbs.



5 x 4″ Angle
11.0 to 24.2 lbs.



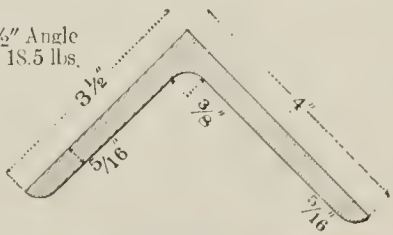
4 x 3″ Angle
7.1 to 17.1 lbs.



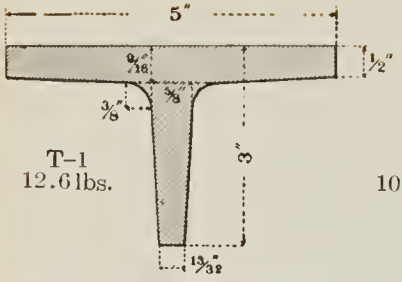
5 x 3½″ Angle
8.7 to 22.7 lbs.

5 x 3″ Angle
8.2 to 19.9 lbs.

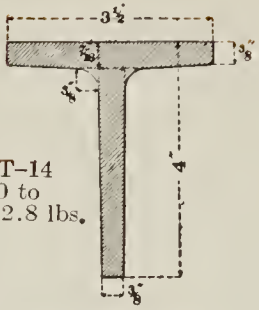
4 x 3½″ Angle
7 7 to 18.5 lbs.



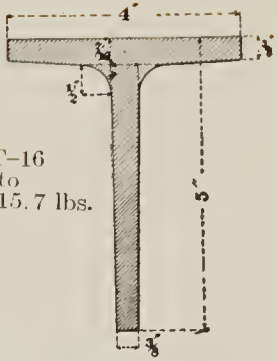
TEES



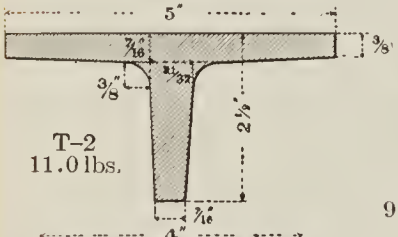
T-1
12.6 lbs.



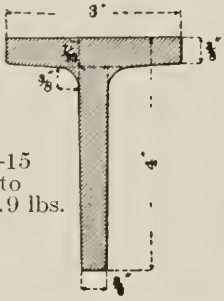
T-14
10.0 to
12.8 lbs.



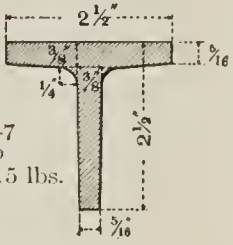
T-16
12.2 to
15.7 lbs.



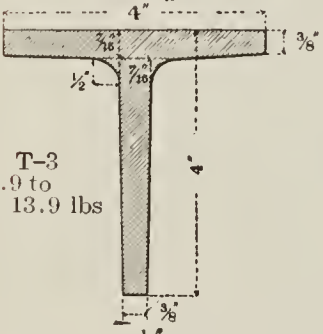
T-2
11.0 lbs.



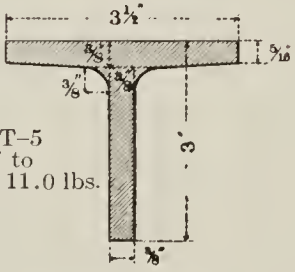
T-15
9.3 to
11.9 lbs.



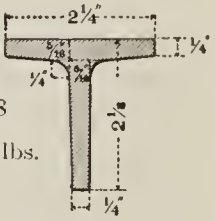
T-7
5.6 to
6.5 lbs.



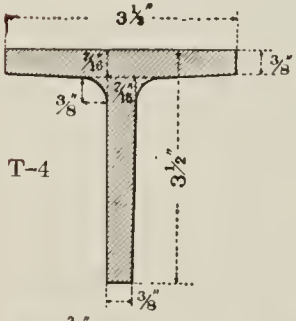
T-3
10.9 to
13.9 lbs



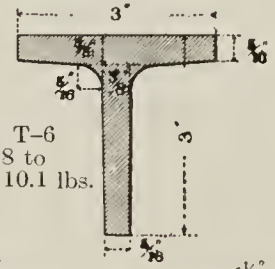
T-5
7.7 to
11.0 lbs.



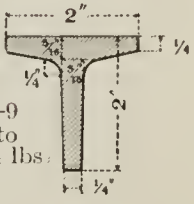
T-8
4.2 to
5 lbs.



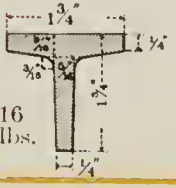
T-4



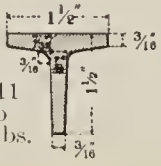
T-6
6.8 to
10.1 lbs.



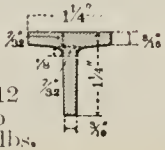
T-9
3.7 to
4.4 lbs.



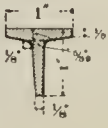
T-16
3.1 lbs.



T-11
2.0 to
2.6 lbs.

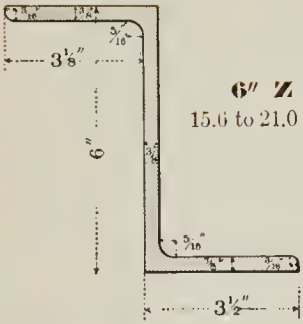


T-12
1.7 to
2.1 lbs.

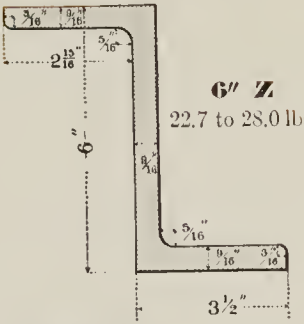


T-13
1.0 to
1.3 lbs.

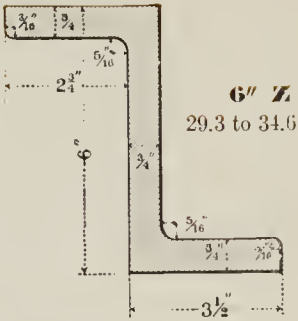
Z-BARS



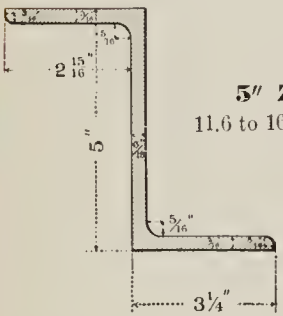
6" Z
15.6 to 21.0 lbs.



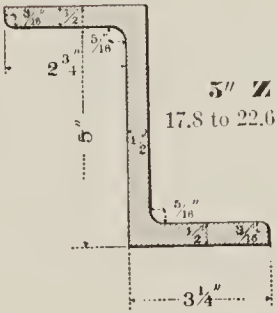
6" Z
22.7 to 28.0 lbs.



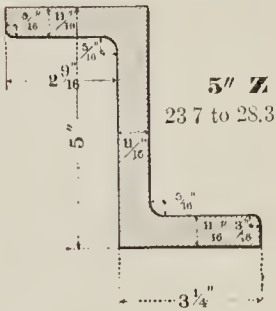
6" Z
29.3 to 34.6 lbs



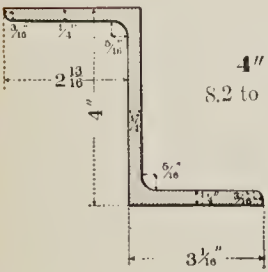
5" Z
11.6 to 16.4 lbs.



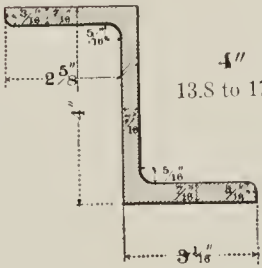
5" Z
17.8 to 22.6 lbs.



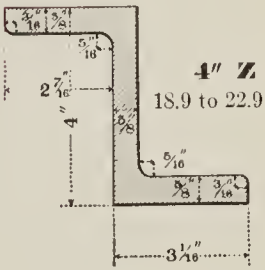
5" Z
23 7 to 28.3 lbs.



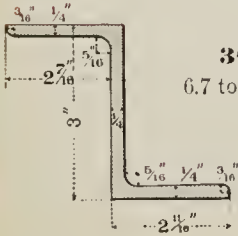
4" Z
8.2 to 12.4 lbs.



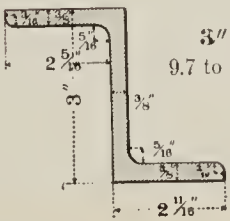
4" Z
13.8 to 17.9 lbs.



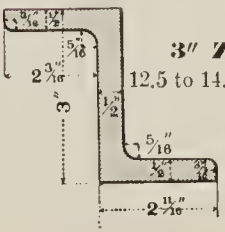
4" Z
18.9 to 22.9 lbs.



3" Z
6.7 to 8.4 lbs.



3" Z
9.7 to 11.4 lbs



3" Z
12.5 to 14.2 lbs.

AREAS OF STEEL ANGLES

Size in Inches	1/8″	3/16″	1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
8 x 8	....	....	....	....	....	....	7.75	8.68	9.61	10.53	11.44	12.34	13.23	14.12	15.00
7 x 3½	....	....	....	....	....	4.40	5.00	5.59	6.17	6.75	7.31	7.87	8.42	8.97	9.50
6 x 6	....	....	....	....	4.36	5.06	5.75	6.43	7.11	7.78	8.44	9.09	9.74	10.37	11.00
6 x 4	....	....	....	....	3.61	4.18	4.75	5.31	5.86	6.41	6.94	7.47	7.99	8.50	9.00
6 x 3½	....	....	....	....	3.42	3.97	4.50	5.03	5.55	6.06	6.56	7.06	7.55	8.03	8.50
5 x 5	....	....	....	....	3.61	4.18	4.75	5.31	5.86	6.42	6.94	7.46	7.99	8.50	9.00
5 x 4	....	....	....	...	3.23	3.75	4.25	4.75	5.23	5.72	6.19	6.65	7.11	.....	.....
5 x 3½	....	....	....	2.56	3.05	3.53	4.00	4.47	4.92	5.37	5.81	6.25	6.67	.....	.....
5 x 3	....	....	....	2.40	2.86	3.31	3.75	4.18	4.61	5.03	5.44	5.84	.....	.....	.....
4 x 4	....	....	....	2.40	2.86	3.31	3.75	4.18	4.61	5.03	5.44	5.84	.....	.....	.....
4 x 3½	....	....	....	2.25	2.67	3.09	3.50	3.90	4.30	4.68	5.06	5.43	.....	.....	.....
4 x 3	....	....	....	2.09	2.48	2.87	3.25	3.62	3.98	4.34	4.69	5.03	.....	.....	.....
3½ x 3½	....	....	....	2.09	2.48	2.87	3.25	3.62	3.98	4.34	4.69	5.03	.....	.....	.....
3½ x 3	....	....	....	1.93	2.30	2.65	3.00	3.34	3.67	4.00	4.31	4.62	.....	.....	.....
3½ x 2½	....	....	1.44	1.78	2.11	2.43	2.75	3.06	3.36	3.65	.....	.....	.....	.....	.....
3 x 3	....	....	1.44	1.78	2.11	2.43	2.75	3.06	3.36	.....	.....	.....	.....	.....	.....
3 x 2½	....	....	1.31	1.62	1.92	2.22	2.50	2.78	....	.....	.....	.....	.....	.....	.....
3 x 2	....	....	1.19	1.47	1.73	2.00	2.25	....	....	.....	.....	.....	.....	.....	.....
2½ x 2½	....	0.90	1.19	1.47	1.73	2.00	2.25	....	....	.....	.....	.....	....	.....	.....
2½ x 2	....	0.81	1.06	1.31	1.55	1.78	2.00	....	....	.....	.....	.....	....	.....	.....
2 x 2	....	0.72	0.94	1.15	1.36	1.56	....	....	....	.....	.....	.....	.....	.....	.....
2 x 1⅜	....	0.60	0.78	....	....	....	....	....	....	.....	.....	.....	.....	.....	.....
1¾ x 1¾	....	0.62	0.81	1.00	1.17	1.30	....	....	....	.....	.....	.....	.....	.....	.....
1½ x 1½	0.36	0.53	0.69	0.84	0.99	....	....	....	....	.....	.....	.....	.....	.....	.....
1¼ x 1¼	0.30	0.43	0.56	0.69	....	....	....	....	....	.....	.....	.....	.....	.....	.....
Areas to be deducted for one Hole. — Size of Holes															
9/16″	.08	.12	.16	.20	.23	.27	.31	.35	.39	.43	.47	.51	.55	.59	.63
11/16″	.09	.14	.19	.23	.28	.33	.38	.42	.47	.52	.56	.61	.66	.70	.75
13/16″	.11	.16	.22	.27	.33	.38	.44	.49	.55	.60	.66	.71	.77	.82	.88
15/16″	.13	.19	.25	.31	.38	.44	.50	.56	.63	.69	.75	.81	.88	.94	1.

NOTE: In computing area to be deducted for rivet holes 1/16″ is added to diameter as given to allow for injury to metal in punching.

WEIGHTS OF STEEL ANGLES

Size in Inches	1/8″	3/16″	1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16	1″
8 x 8	....	....	....	....	....	....	26.4	29.5	32.7	35.8	38.9	42.0	45.0	48.0	51.0
7 x 3½	....	....	....	....	....	15.0	17.0	19.0	21.0	23.0	24.9	26.8	28.7	30.5	32.3
6 x 6	....	....	....	....	14.8	17.2	19.6	21.9	24.2	26.5	28.7	30.9	33.1	35.3	37.4
6 x 4	....	....	....	....	12.3	14.3	16.2	18.1	20.0	21.8	23.6	25.4	27.2	28.9	30.6
6 x 3½	....	....	....	....	11.7	13.5	15.3	17.1	18.9	20.6	22.3	24.0	25.7	27.3	28.9
5 x 5	....	....	....	....	12.3	14.3	16.2	18.1	20.0	21.8	23.6	25.4	27.2	28.9	30.6
5 x 4	....	....	....	....	11.0	12.8	14.5	16.2	17.8	19.5	21.1	22.6	24.2	.....	.....
5 x 3½	....	....	....	8.7	10.4	12.0	13.6	15.2	16.8	18.3	19.8	21.3	22.7	.....	.....
5 x 3	.. .	....	....	8.2	9.8	11.3	12.8	14.2	15.7	17.1	18.5	19.9	.....	.....	. ..
4 x 4	....	....	....	8.2	9.8	11.3	12.8	14.3	15.7	17.1	18.5	19.9	.....	.....	.....
4 x 3½	.. .	....	....	7.7	9.1	10.5	11.9	13.3	14.6	15.9	17.2	18.5	.....	. ...	.....
4 x 3	....	....	....	7.1	8.5	9.8	11.1	12.3	13.6	14.8	16.0	17.1	.....	.....	. ....
3½ x 3½	.. .	....	....	7.1	8.5	9.8	11.1	12.3	13.6	14.8	16.0	17.1	.....	.....	..
3½ x 3	....	....	....	6.6	7.8	9.1	10.2	11.4	12.5	13.6	14.7	15.7	.....	.....	.....
3½ x 2½	....	....	4.9	6.1	7.2	8 3	9.4	10.4	11.4	12.4	.....	.....	.....	....	.....
3 x 3	....	....	4.9	6.1	7.2	8.3	9.4	10.4	11.4	.....	...	.....	.....	.....	.....
3 x 2½	....	....	4.5	5.5	6.6	7.6	8.5	9.5	....	.....	...	....	.....	...	.....
3 x 2	....	....	4.0	5.0	5.9	6.8	7.7	....	....	....	.....	....	....	. .	.....
2½ x 2½	...	3.1	4.1	5.0	5.9	6.8	7.7	....	....	....	....	...	.....	.....	.....
2½ x 2	....	2.8	3.7	4.5	5.3	6.1	6.8	....	....	.....	...	.....	.	..	.....
2 x 2	....	2.5	3.2	4.0	4.7	5.3	....	....	....	.....	...	...	.....	....	. ....
2 x 1⅜	. ..	2.1	2.7	....	....	....	....	....	. .	. .	....	...	.....	... ..	.....
1¾ x 1¾	....	2.1	2.8	3.4	4.0	4.6	....	..	....	....	.....	....	.....	. ....	.....
1½ x 1½	1.2	1.8	2.4	2.9	3.4	...	....	...	....	.....	.....	...	.....	.....	.. ...
1¼ x 1¼	1.0	1.5	1.9	2.4	...	....	....	...	.	..	.	..	.....	... .	... .
1 x 1	0.8	1.2	1.5	. .	. .	..	....	....	..		....	...	. . .	. . ..	... .

WEIGHTS AND DIMENSIONS OF TEES. EQUAL LEGS.

Size, Inches		Thickness of Metal, Inches.		Wt. per ft. lbs.
Flange	Stem.	Flange	Stem	
4	4	1/2 to 9/16	1/2 to 9/16	13.9
4	4	3/8 to 7/16	3/8 to 7/16	10.9
3 1/2	3 1/2	1/2 to 9/16	1/2 to 9/16	11.9
3 1/2	3 1/2	3/8 to 7/16	3/8 to 7/16	9.3
3	3	1/2 to 9/16	1/2 to 9/16	10.1
3	3	7/16 to 1/2	7/16 to 1/2	9.0
3	3	3/8 to 7/16	3/8 to 7/16	7.9
3	3	5/16 to 3/8	5/16 to 3/8	6.8
2 1/2	2 1/2	3/8 to 7/16	3/8 to 7/16	6.5
2 1/2	2 1/2	5/16 to 3/8	5/16 to 3/8	5.6
2 1/4	2 1/4	5/16 to 3/8	5/16 to 3/8	5.0
2 1/4	2 1/4	1/4 to 5/16	1/4 to 5/16	4.2
2	2	5/16 to 3/8	5/16 to 3/8	4.4
2	2	1/4 to 5/16	1/4 to 5/16	3.7
1 3/4	1 3/4	1/4 to 5/16	1/4 to 5/16	3.2
1 1/2	1 1/2	1/4 to 9/32	1/4 to 9/32	2.6
1 1/2	1 1/2	3/16 to 7/32	3/16 to 7/32	2.0
1 1/4	1 1/4	1/4 to 9/32	1/4 to 9/32	2.1
1 1/4	1 1/4	3/16 to 7/32	3/16 to 7/32	1.7
1	1	3/16 to 7/32	3/16 to 7/32	1.3
1	1	1/8 to 5/32	1/8 to 5/32	1.0
.....	.....	.....	.....	.....

WEIGHTS AND DIMENSIONS OF TEES. UNEQUAL LEGS.

Size, Inches		Thickness of Metal, Inches		Wt. per ft. lbs.
Flange	Stem	Flange.	Stem.	
5	3	1/2 to 9/16	13/32 to 5/8	13.6
5	2 1/2	3/8 to 7/16	7/16 to 21/32	11.0
4	5	1/2 to 9/16	1/2 to 9/16	15.7
4	5	3/8 to 7/16	3/8 to 7/16	12.3
4	3	3/8 to 7/16	3/8 to 7/16	9.3
3 1/2	4	1/2 to 9/16	1/2 to 9/16	12.8
3 1/2	4	3/8 to 7/16	3/8 to 7/16	10.0
3 1/2	3	1/2 to 9/16	1/2 to 9/16	11.0
3 1/2	3	3/8 to 7/16	3/8 to 7/16	8.7
3 1/2	3	5/16 to 3/8	3/8	7.7
3	4	1/2 to 9/16	1/2 to 9/16	11.9
3	4	7/16 to 1/2	7/16 to 1/2	10.6
3	4	3/8 to 7/16	3/8 to 7/16	9.3
3	3 1/2	1/2 to 9/16	1/2 to 9/16	11.0
3	3 1/2	7/16 to 1/2	7/16 to 1/2	9.8
3	3 1/2	3/8 to 7/16	3/8 to 7/16	8.6
3	2 1/2	3/8 to 7/16	3/8 to 7/16	7.2
3	2 1/2	5/16 to 3/8	5/16 to 3/8	6.2
2 1/2	3	3/8 to 7/16	3/8 to 7/16	7.2
2 1/2	3	5/16 to 3/8	5/16 to 3/8	6.2
2 1/2	1 1/4	3/16 to 9/32	3/16 to 5/16	3.0
2	1 1/2	1/4 to 5/16	1/4 to 5/16	3.2

Write size of Tees: Flange by Stem by Weight per foot.

WEIGHTS AND DIMENSIONS OF STANDARD Z-BARS

SIZE IN INCHES			Thickness of Metal Inches	Weight per foot Pounds
Flange	Web	Flange		
3½	6	3½	3/8	15.6
3 9/16	6 1/16	3 9/16	7/16	18.3
3⅝	6⅛	3⅝	½	21.0
3½	6	3½	9/16	22.7
3 9/16	6 1/16	3 9/16	5/8	25.4
3⅝	6⅛	3⅝	11/16	28.0
3½	6	3½	¾	29.3
3 9/16	6 1/16	3 9/16	13/16	32.0
3⅝	6⅛	3⅝	7/8	34.6
3¼	5	3¼	5/16	11.6
3 5/16	5 1/16	3 5/16	3/8	13.9
3⅜	5⅛	3⅜	7/16	16.4
3¼	5	3¼	½	17.8
3 5/16	5 1/16	3 5/16	9/16	20.2
3⅜	5⅛	3⅜	5/8	22.6
3¼	5	3¼	11/16	23.7
3 5/16	5 1/16	3 5/16	¾	26.0
3⅜	5⅛	3⅜	13/16	28.3
3 1/16	4	3 1/16	¼	8.2
3⅛	4 1/16	3⅛	5/16	10.3
3 3/16	4⅛	3 3/16	3/8	12.4
3 1/16	4	3 1/16	7/16	13.8
3⅛	4 1/16	3⅛	½	15.8
3 3/16	4⅛	3 3/16	9/16	17.9
3 1/16	4	3 1/16	5/8	18.9
3⅛	4 1/16	3⅛	11/16	20.9
3 3/16	4⅛	3 3/16	¾	22.9
2 11/16	3	2 11/16	¼	6.7
2¾	3 1/16	2¾	5/16	8.4
2 11/16	3	2 11/16	3/8	9.7
2¾	3 1/16	2¾	7/16	11.4
2 11/16	3	2 11/16	½	12.5
2¾	3 1/16	2¾	9/16	14.2

WEIGHT OF STEEL PLATE

POUNDS PER LINEAL FOOT

Width in Inches	THICKNESS IN INCHES													
	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
1	.638	.850	1.06	1.28	1.49	1.70	1.92	2.12	2.34	2.55	2.76	2.98	3.19	3.40
1¼	.797	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.19	3.45	3.72	3.99	4.25
1½	.957	1.28	1.59	1.92	2.23	2.55	2.87	3.19	3.51	3.83	4.14	4.47	4.78	5.10
1¾	1.11	1.49	1.86	2.23	2.60	2.98	3.35	3.72	4.09	4.47	4.84	5.20	5.58	5.95
2	1.28	1.70	2.12	2.55	2.98	3.40	3.83	4.25	4.67	5.10	5.53	5.95	6.38	6.80
2¼	1.44	1.91	2.39	2.87	3.35	3.83	4.30	4.78	5.26	5.75	6.21	6.69	7.18	7.65
2½	1.59	2.12	2.65	3.19	3.72	4.25	4.78	5.31	5.84	6.38	6.90	7.44	7.97	8.50
2¾	1.75	2.34	2.92	3.51	4.09	4.67	5.26	5.84	6.43	7.02	7.60	8.18	8.77	9.35
3	1.91	2.55	3.19	3.83	4.46	5.10	5.74	6.38	7.02	7.65	8.29	8.93	9.57	10.20
3¼	2.07	2.76	3.45	4.15	4.83	5.53	6.22	6.91	7.60	8.29	8.98	9.67	10.36	11.05
3½	2.23	2.98	3.72	4.47	5.20	5.95	6.70	7.44	8.18	8.93	9.67	10.41	11.16	11.90
3¾	2.39	3.19	3.99	4.78	5.58	6.38	7.17	7.97	8.76	9.57	10.36	11.16	11.95	12.75
4	2.55	3.40	4.25	5.10	5.95	6.80	7.65	8.50	9.35	10.20	11.05	11.90	12.75	13.60
4½	2.87	3.83	4.78	5.74	6.70	7.65	8.61	9.57	10.52	11.48	12.43	13.39	14.34	15.30
5	3.19	4.25	5.31	6.38	7.44	8.50	9.57	10.63	11.69	12.75	13.81	14.87	15.94	17.00
5½	3.51	4.67	5.84	7.02	8.18	9.35	10.52	11.69	12.85	14.03	15.19	16.36	17.53	18.70
6	3.83	5.10	6.38	7.65	8.93	10.20	11.48	12.75	14.03	15.30	16.58	17.85	19.13	20.40
6½	4.14	5.53	6.90	8.29	9.67	11.05	12.43	13.81	15.20	16.58	17.95	19.34	20.72	22.10
7	4.46	5.95	7.44	8.93	10.41	11.90	13.39	14.87	16.36	17.85	19.34	20.83	22.32	23.80
7½	4.78	6.36	7.97	9.57	11.16	12.75	14.34	15.94	17.53	19.13	20.72	22.32	23.91	25.50
8	5.10	6.80	8.50	10.20	11.90	13.60	15.30	17.00	18.70	20.40	22.10	23.80	25.50	27.20
9	5.74	7.65	9.56	11.48	13.40	15.30	17.22	19.13	21.04	22.96	24.86	26.78	28.69	30.60
10	6.38	8.50	10.62	12.75	14.88	17.00	19.14	21.25	23.38	25.50	27.62	29.75	31.88	34.00
11	7.02	9.34	11.68	14.03	16.36	18.70	21.92	23.38	25.70	28.05	30.40	32.72	35.06	37.40
12	7.65	10.20	12.75	15.30	17.85	20.40	22.95	25.50	28.05	30.60	33.15	35.70	38.25	40.80
13	8.28	11.06	13.81	16.58	19.34	22.10	24.86	27.62	30.39	33.16	35.91	38.68	41.44	44.20
14	8.92	11.90	14.88	17.86	20.82	23.80	26.78	29.74	32.72	35.71	38.67	41.65	44.63	47.60
15	9.56	12.75	15.94	19.14	22.32	25.50	28.70	31.88	35.06	38.26	41.43	44.62	47.82	51.00
16	10.20	13.60	17.00	20.40	23.80	27.20	30.60	34.00	37.40	40.80	44.20	47.60	51.00	54.40
17	10.84	14.44	18.06	21.68	25.28	28.89	32.52	36.12	39.72	43.36	46.96	50.60	54.20	57.80
18	11.48	15.30	19.12	22.96	26.79	30.60	34.44	38.25	42.08	45.92	49.72	53.56	57.38	61.20
19	12.10	16.16	20.20	24.24	28.28	32.31	36.34	40.37	44.42	48.46	52.48	56.52	60.57	64.60
20	12.76	17.00	21.24	25.50	29.75	34.00	38.27	42.50	46.74	51.00	55.25	59.50	63.76	68.00
21	13.40	17.84	22.32	26.78	31.24	35.70	40.16	44.64	49.08	53.56	58.01	62.49	66.96	71.40
22	14.04	18.69	23.36	28.06	32.72	37.40	42.04	46.76	51.40	56.10	60.79	65.44	70.13	74.80
23	14.64	19.56	24.44	29.36	34.24	39.10	44.00	48.88	53.76	58.66	63.53	68.43	73.32	78.20
24	15.32	20.40	25.52	30.60	35.72	40.80	45.92	51.00	56.12	61.20	66.29	71.40	76.50	81.60
26	16.56	22.12	27.62	33.16	38.68	44.20	49.73	55.24	60.78	66.32	71.82	77.36	82.88	88.40
28	17.84	23.80	29.76	35.72	41.65	47.60	53.56	59.49	65.44	71.42	77.34	83.30	89.26	95.20
30	19.12	25.50	31.88	38.28	44.64	51.00	57.40	63.76	70.13	76.53	82.86	89.24	95.64	102.0
36	22.96	30.59	38.24	45.92	53.58	61.20	68.88	76.50	84.15	91.84	99.44	107.12	114.76	122.4
42	26.80	35.68	44.64	53 56	62.48	71.40	80.32	89.28	98.16	107.12	116.0	125.0	133.9	142.8

WEIGHT OF SHEET STEEL

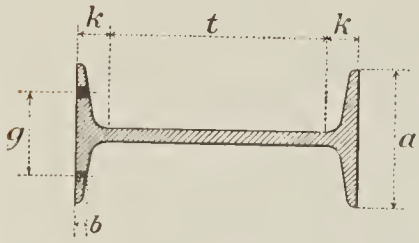
POUNDS PER LINEAL FOOT

United States Standard Gauge

Number of Gauge	Approximate Thickness in Fractions of an Inch	Approximate Thickness in Decimal Parts of an Inch	WIDTH IN INCHES											
			20	**22**	**24**	**26**	**28**	**30**	**36**	**42**	**48**	**50**	**54**	**60**
1	$\frac{9}{32}$	.28125	19.12	21.05	22.96	24.88	26.80	28.70	34.42	40.15	45.88	47.79	51.61	57.34
2	$\frac{17}{64}$	.26562	18.06	19.88	21.69	23.50	25.31	27.09	32.51	37.94	43.37	45.18	48.80	54.18
3	$\frac{1}{4}$	.25	17.00	18.71	20.40	22.09	23.78	25.50	30.60	35.72	40.84	42.49	45.91	51.00
4	$\frac{15}{64}$	.23437	15.94	17.54	19.14	20.74	22.31	23.90	28.69	33.48	38.27	39.84	43.04	47.80
5	$\frac{7}{32}$	.21875	14.87	16.37	17.86	19.35	20.84	22.31	26.78	31.25	35.72	37.17	40.17	44.62
6	$\frac{13}{64}$	.20313	13.81	15.20	16.57	17.95	19.33	20.72	24.86	29.00	33.14	34.51	37.28	41.44
7	$\frac{3}{16}$	.1875	12.76	14.03	15.30	16.57	17.84	19.12	22.95	26.78	30.61	31.86	34.40	38.24
8	$\frac{11}{64}$	.17188	11.68	12.86	14.03	15.20	16.37	17.53	21.04	24.55	28.06	29.21	31.55	35.06
9	$\frac{5}{32}$	.15625	10.62	11.69	12.75	13.81	14.87	15.94	19.13	22.32	25.51	26.55	28.67	31.88
10	$\frac{9}{64}$	.14063	9.56	10.51	11.46	12.41	13.36	14.34	17.21	20.08	22.95	23.90	25.80	28.68
11	$\frac{1}{8}$	.125	8.50	9.35	10.20	11.05	11.90	12.75	15.30	17.85	20.40	21.25	22.95	25.50
12	$\frac{7}{64}$	.10938	7.43	8.18	8.93	9.68	10.43	11.16	13.39	15.62	17.85	18.59	20.09	22.32
13	$\frac{3}{32}$	.09375	6.37	7.00	7.64	8.28	8.92	9.56	11.47	13.38	15.29	15.93	17.21	19.12
14	$\frac{5}{64}$	.07813	5.31	5.83	6.36	6.89	7.42	7.97	9.56	11.15	12.74	13.28	14.34	15.94
15	$\frac{9}{128}$	.07031	4.78	5.25	5.73	6.21	6.69	7.17	8.64	10.11	11.58	11.94	12.90	14.34
16	$\frac{1}{16}$	.0625	4.25	4.67	5.09	5.51	5.93	6.37	7.65	8.93	10.21	10.61	11.45	12.74
17	$\frac{9}{160}$	.05625	3.82	4.20	4.58	4.96	5.34	5.74	6.89	8.04	9.19	9.56	10.32	11.48
18	$\frac{1}{20}$	.05	3.40	3.74	4.08	4.42	4.76	5.10	6.12	7.14	8.16	8.49	9.17	10.20
19	$\frac{7}{160}$	.04375	2.97	3.27	3.57	3.87	4.17	4.46	5.36	6.26	7.10	7.43	8.03	8.92
20	$\frac{3}{80}$	.0375	2.55	2.81	3.07	3.32	3.58	3.82	4.59	5.36	6.13	6.37	6.89	7.64

DIMENSIONS OF BEAMS AND CHANNELS

GAUGES OF ANGLES

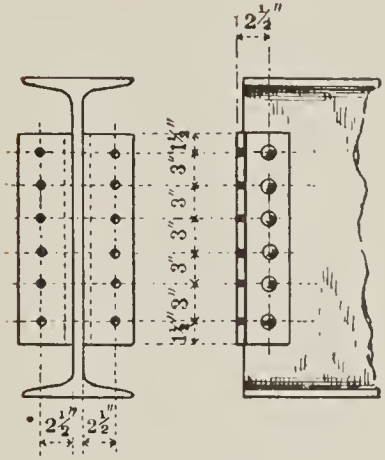


I ins.	Weight lbs.	a ins.	Web thickness ins.	Gauge g ins.	Tang't t ins.	Dist. k ins.	Grip b ins.	Max. size of rivet or bolt ins.
24	100	7 1/4	3/4	4	20 3/4	1 5/8	7/8	1
24	90	7 1/8	5/8	4	20 3/4	1 5/8	7/8	1
24	80	7	1/2	4	20 3/4	1 5/8	7/8	1
20	80	7	19/32	4	16 1/2	1 3/4	15/16	7/8
20	70	6 5/16	9/16	3 1/2	17	1 1/2	3/4	7/8
20	65	6 1/4	1/2	3 1/2	17	1 1/2	3/4	7/8
18	70	6 1/4	23/32	3 1/4	15 1/4	1 3/8	5/8	7/8
18	55	6	7/16	3 1/4	15 1/4	1 3/8	5/8	7/8
15	60	6	19/32	3 1/4	11 3/4	1 5/8	3/4	3/4
15	50	5 7/8	17/32	3	12 1/2	1 1/4	5/8	3/4
15	42	5 1/2	13/32	3	12 1/2	1 1/4	5/8	3/4
12	50	5 1/2	11/16	3	9 1/4	1 3/8	11/16	3/4
12	40	5 1/4	7/16	3	9 1/4	1 3/8	11/16	3/4
12	31.5	5	11/32	2 3/4	9 3/4	1 1/8	1/2	3/4
10	30	4 13/16	15/32	2 5/8	8	1	7/16	3/4
10	25	4 5/8	5/16	2 5/8	8	1	7/16	3/4
9	25	4 7/16	7/16	2 1/2	7	1	7/16	3/4
9	21	4 5/16	9/32	2 1/2	7	1	7/16	3/4
8	18	4	1/4	2 1/4	6 1/4	7/8	7/16	3/4
7	15	3 31/32	1/4	2 1/4	5 1/4	7/8	3/8	5/8
6	12 1/4	3 5/16	7/32	2	4 1/2	3/4	3/8	5/8
5	9.75	3	7/32	1 3/4	3 1/2	3/4	5/16	1/2
4	7.5	2 31/32	3/16	1 1/2	2 3/4	5/8	5/16	1/2
3	5.5	2 5/16	5/32	1 7/16	1 3/4	5/8	1/4	3/8

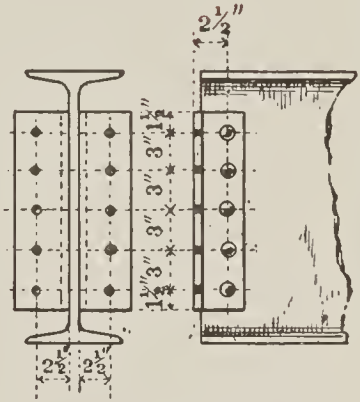
⊏ ins.	Weight lbs.	a ins.	Web thickness ins.	Gauge g ins.	Tang't t ins.	Dist. k ins.	Grip b ins.	Max. size of rivet or bolt ins.
15	50	3 23/32	23/32	2 1/4	12 1/4	1 3/8	5/8	3/4
15	40	3 17/32	17/32	2	12 1/4	1 3/8	5/8	3/4
15	33	3 13/32	13/32	1 7/8	12 1/4	1 3/8	5/8	3/4
12	40	3 13/32	3/4	2	10	1	1/2	3/4
12	30	3 5/32	1/2	2	10	1	1/2	3/4
12	20 1/2	2 15/16	9/32	1 3/4	10	1	1/2	3/4
10	30	3 1/32	21/32	1 3/4	8 1/4	7/8	1/2	3/4
10	15	2 19/32	7/32	1 1/2	8 1/4	7/8	7/16	3/4
9	13 1/4	2 7/16	7/32	1 3/8	7 1/4	7/8	7/16	3/4
8	11 1/4	2 1/4	7/32	1 1/4	6 1/4	7/8	3/8	3/4
7	9 3/4	2 3/32	3/16	1 1/4	5 1/2	3/4	3/8	5/8
6	8	1 29/32	3/16	1 1/8	4 1/2	3/4	3/8	5/8
5	6 1/2	1 3/4	3/16	1	3 3/4	5/8	5/16	1/2
4	5 1/4	1 9/16	3/16	1	2 3/4	5/8	3/16	1/2
3	4	1 13/32	5/32	15/16	1 3/4	5/8	1/4	3/8

Leg	a	Max. Rivet	Leg	b	c	Max. Rivet
4 "	2 1/2"	7/8"	8"	3 "	3 "	1" Variable
3 1/2"	2 "	7/8"	7"	2 1/2"	3 "	
3 "	1 3/4"	7/8"	6"	2 "	2 1/2"	
2 1/2"	1 3/8"	3/4"	5"	1 3/4"	2 "	
2 "	1 1/8"	5/8"				
1 3/4"	1 "	1/2"				

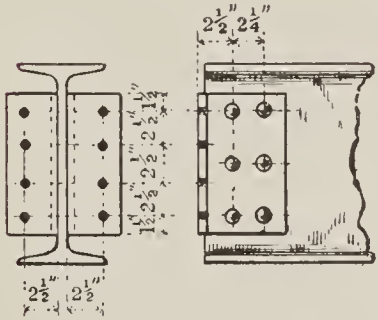
STANDARD CONNECTIONS FOR I-BEAMS AND CHANNELS



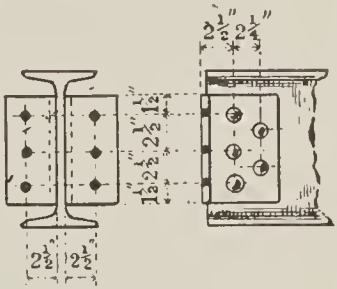
4x4x⅜" L–1′–6" lg. Weight 38.4 lbs, for 24" I's.



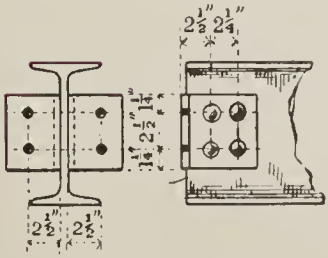
4x4x⅜" L–1′–3" lg. Weight 32 lbs, for 18" and 20" I's



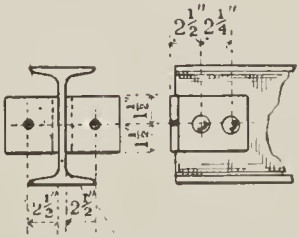
6x4x⅜" L–0′–10⅓" lg. Weight 28 lbs. for 15" I's and ⊏'s



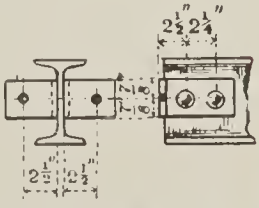
6x4x⅜" L–0′–8" lg. Weight 21.9 lbs. for 12" I's and ⊏'s.



6x4x⅜"L.0′5"lg.,wt.13.8 lbs. for 7, 8, 9, 10" I's and ⊏'s. All holes for ¾" bolts and rivets.



6x4x⅜"L. 0′3"lg.,wt.8.2 lbs. for 5, 6" I's and ⊏'s.



6x4x⅜"L.0′1¾"lg.,wt.5.6 lbs. for 3, 4" I's and ⊏'s.

Weights of connections include both shop and field rivets.

BEARING PLATES FOR BEAMS AND CHANNELS ON BRICK AND MASONRY

Size of Beams or Channels	Bearing on Wall, Inches	Size, Inches	CAST IRON		STEEL		Safe Bearing Values in Tons for Plates Resting on		
			Thickness Inches	Weight	Thickness Inches	Weight	Common Brick	First Class Brick	Ordinary Masonry
3, 4, 5 and 6″	6	6 x 6	5/8	6	3/8	4	1.8	2.7	4.5
	6	6 x 6	3/4	7	1/2	5			
7 and 8″	8	8 x 8	3/4	13	1/2	9	3.2	4.8	8.0
	8	8 x 8	1	17	3/4	14			
9 and 10″	8	8 x 12	1	25	1/2	14	4.8	7.2	12.0
	8	8 x 12	1 1/4	31	3/4	20			
12″ 31.5 lbs.	12	12 x 12	1	38	1/2	20	7.2	10.8	18.0
	12	12 x 12	1 1/4	47	3/4	31			
12″ 40 lbs. and up, and 15″ 42 lbs.	12	12 x 16	1 1/4	63	3/4	41	9.6	14.4	24.0
	12	12 x 16	1 1/2	75	1	54			
15″ 60 and 80 lbs.	12	12 x 18	1 3/4	98	3/4	46	10.8	16.2	27.0
	12	12 x 18	2	113	1	61			
18, 20 and 24″	16	16 x 16	1 3/4	117	1	73	12.8	19.2	32.0
	16		2	133					

Above bearing values are based on the following table:

Allowable load on brick work—100 lbs. per square inch.

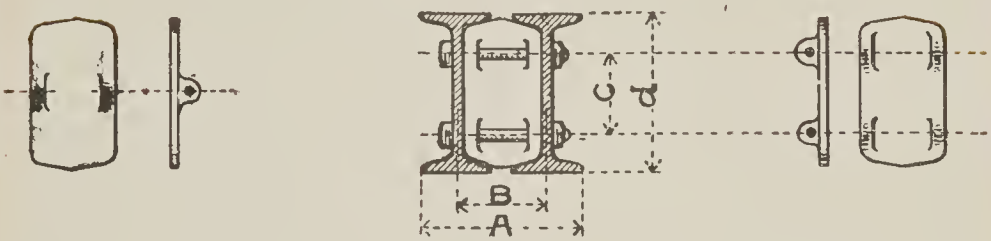
Allowable load on 1st class work—150 lbs. per square inch.

Allowable load on masonry—250 lbs. per square inch.

Use the thicker plate for bearing values exceeding those given under common brick work.

When end reaction exceeds the above safe bearing values, special plates will be required; 20″ and 24″ beams will usually require special calculations.

STANDARD CAST-IRON SEPARATORS FOR I-BEAMS



Separators for 18, 20 and 24″ beams are made of $\frac{5}{8}$″ metal.
Separators for 6 to 15″ beams are made of $\frac{1}{2}$″ metal.
Separators for 5″ beams and under are made of $\frac{3}{8}$″ metal.

SEPARATORS WITH ONE BOLT

BEAMS				BOLTS			WEIGHTS			
Depth	Weight	Out to Out of Flanges of Beams	Center to Center of Beams	Size	Distance Center to Center	Length	Bolts and Nuts	Increase in wt. of Separator Bolts for 1″ additional spread of Beams	Separator	Increase in wt. of Separator for 1″ additional spread of Beams
Inches	Pounds	Inches	Inches	Inches	Inches	Inches	Pounds	Pounds	Pounds	Pounds
3	5.50	$5\frac{5}{16}$	3	$\frac{5}{8}$	.....	$4\frac{1}{4}$	0.70	.09	2.	.25
4	7.50	$5\frac{7}{8}$	$3\frac{1}{4}$	$\frac{3}{4}$	.....	$4\frac{1}{2}$	1.13	.125	3.	.40
5	9.75	$6\frac{1}{2}$	$3\frac{1}{2}$	$\frac{3}{4}$	.....	$4\frac{3}{4}$	1.16	.125	3.	.50
6	12.25	$7\frac{5}{16}$	4	$\frac{3}{4}$	.....	$5\frac{1}{4}$	1.22	.125	4.	.60
7	15.0	$7\frac{7}{8}$	$4\frac{1}{4}$	$\frac{3}{4}$	.....	$5\frac{1}{2}$	1.25	.125	4.	.75
8	18.0	$8\frac{1}{2}$	$4\frac{1}{2}$	$\frac{3}{4}$	.....	$5\frac{3}{4}$	1.28	.125	6.	1.00
9	21.0	$9\frac{5}{16}$	5	$\frac{3}{4}$	.....	$6\frac{1}{4}$	1.34	.125	7.	1.20
10	25.0	$10\frac{1}{8}$	$5\frac{1}{2}$	$\frac{3}{4}$	.....	$6\frac{3}{4}$	1.40	.125	8.	1.25
12	31.5	$10\frac{3}{4}$	$5\frac{3}{4}$	$\frac{3}{4}$	.....	$7\frac{1}{4}$	1.46	.125	10.	1.50
12	40.0	$11\frac{1}{4}$	6	$\frac{3}{4}$	.....	$7\frac{1}{2}$	1.49	.125	10.	1.50

SEPARATORS WITH TWO BOLTS

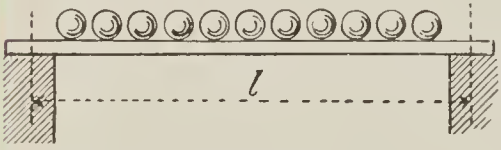
12	31.5	$10\frac{3}{4}$	$5\frac{3}{4}$	$\frac{3}{4}$	6	$7\frac{1}{4}$	2.92	.250	11.	1.50
12	40.	$11\frac{1}{4}$	6	$\frac{3}{4}$	6	$7\frac{1}{2}$	2.98	.250	11.	1.50
15	42.	$11\frac{3}{4}$	$6\frac{1}{4}$	$\frac{3}{4}$	$7\frac{1}{2}$	$7\frac{1}{2}$	2.98	.250	15.	1.75
15	60.	$12\frac{3}{4}$	$6\frac{3}{4}$	$\frac{3}{4}$	$7\frac{1}{2}$	$8\frac{1}{2}$	3.23	.250	15.	1.75
15	80.	$13\frac{5}{8}$	$7\frac{1}{4}$	$\frac{3}{4}$	$7\frac{1}{2}$	9	3.35	.250	15.	1.75
18	55.	$12\frac{3}{4}$	$6\frac{3}{4}$	$\frac{3}{4}$	9	$8\frac{1}{4}$	3.16	.250	16.	2.75
20	65.	$13\frac{1}{4}$	7	$\frac{3}{4}$	10	$8\frac{1}{2}$	3.23	.250	25.	3.10
20	80.	$14\frac{3}{4}$	$7\frac{3}{4}$	$\frac{3}{4}$	10	$9\frac{1}{4}$	3.41	.250	28.	3.10
24	80.	$14\frac{3}{4}$	$7\frac{3}{4}$	$\frac{3}{4}$	12	$9\frac{1}{4}$	3.41	.250	32.	5.50

BENDING MOMENTS AND DEFLECTIONS OF BEAMS UNDER VARIOUS SYSTEMS OF LOADING

W = Total load.

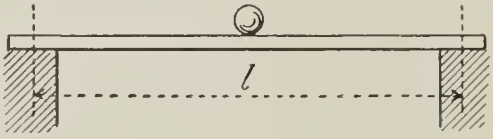
L = Length of beam.

(1) Beam supported at both ends and uniformly loaded.



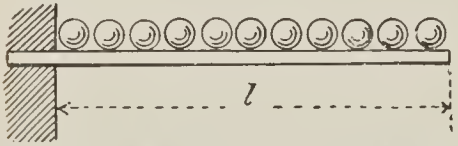
Safe load = that given in tables. Maximum bending moment at center of beam = $\frac{Wl.}{8}$

(2) Beam supported at both ends, single load in middle.



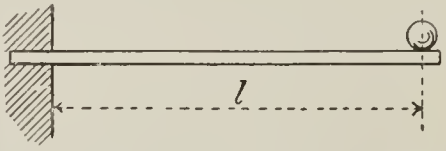
Safe load = ½ that given in tables. Maximum bending moment at center of beam = $\frac{Wl.}{4}$

(3) Beam fixed at one end and uniformly loaded.



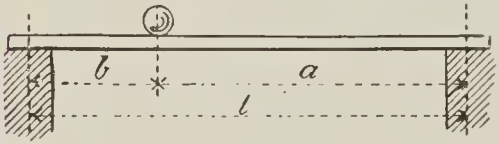
Safe load = ¼ that given in tables. Maximum bending moment at point of support = $\frac{Wl.}{2}$

(4) Beam fixed at one end and loaded at the other.



Safe load = ⅛ that given in tables. Maximum bending moment at point of support = Wl.

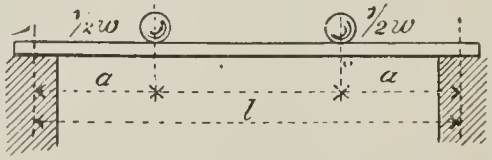
(5) Beam supported at both ends, single unsymmetrical load.



Safe load = that given in tables × $\frac{l^2}{8ab}$

Maximum bending moment under load = $\frac{Wab}{l}$

(6) Beams supported at both ends, two symmetrical loads.



Safe loads = that given in tables × $\frac{1}{4a}$

Maximum bending moment between loads = ½ Wa

Case 1 — Deflection under safe load = that given in tables.
" 2 — " " " " = 8/10 " " " "
" 3 — " " " " = 2.4 " " " "
" 4 — " " " " = 3.2 " " " "

EXPLANATION OF TABLES OF SAFE LOADS

The following tables give the greatest safe load (evenly distributed over the entire length) which the steel shapes used as beams will carry.

These loads include the weight of the beam, which must be deducted to obtain the net load.

On page 26 methods are given for obtaining the safe loads under various systems of loading.

The loads given are based on a fiber stress of 16,000 pounds per square inch, and are entirely reliable for ordinary conditions where loads are quiescent.

For fluctuating loads causing vibration, especially if the beams are long as compared to their depth, the tabular loads should be reduced 1-5; for rapidly moving loads, or where loads are suddenly applied with slight impact, the tabular loads should be reduced 1-3.

It is assumed that the beams are stiffened sideways to prevent buckling in the compression flange, otherwise tabular load must be reduced as follows:

Length of Beam	Proportion of Tabular safe load to be used
20 x Flange width	Whole Tabular Load
30 x " "	$\frac{9}{10}$ " "
40 x " "	$\frac{8}{10}$ " "
50 x " "	$\frac{7}{10}$ " "
60 x " "	$\frac{6}{10}$ " "
70 x " "	$\frac{1}{2}$ " "

In many cases deflection will govern. The allowable deflection for plastered ceilings is $\frac{1}{360}$ of the span. This limit is indicated by heavy lines below which beams should not be used with plastered ceilings unless the loads are reduced.

The deflection will be reduced in the same ratio as the load on the beam.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STEEL I-BEAMS

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of beam

D=the deflection in inches under the safe load.

For safe loads and deflections under various systems of loading, see page 26.

Distance between Supports in Ft.	24″ I						20″ I						18″ I			
	100 lbs.	D	90 lbs.	D	80 lbs.	D	80 lbs.	D	70 lbs.	D	65 lbs.	D	70 lbs.	D	55 lbs.	D
10	211520	.07	198970	.07	185530	.07	156410	.08	130110	.08	124740	.08	109180	.09	94300	.09
11	192290	.08	180880	.08	168660	.08	142190	.10	118280	.10	113400	.10	99250	.11	85720	.11
12	176270	.10	165810	.10	154660	.10	130360	.12	108430	.12	103960	.12	90980	.13	78580	.13
13	162710	.12	153050	.12	142760	.12	120320	.14	100080	.14	95960	.14	83980	.16	72540	.16
14	151080	.14	142120	.14	132560	.14	111740	.16	92950	.16	89120	.16	77990	.18	67360	.18
15	141010	.16	132650	.16	123720	.16	104280	.19	86740	.19	83180	.19	72790	.20	62860	.20
16	132200	.18	124360	.18	116000	.18	97760	.21	81320	.21	77980	.21	68240	.23	58940	.23
17	124420	.20	117040	.20	109160	.20	92020	.24	76540	.24	73380	.24	64220	.27	55480	.27
18	117510	.22	110540	.22	103120	.22	86900	.27	72280	.27	69320	.27	60660	.30	52380	.30
19	111330	.25	104720	.25	97680	.25	82340	.30	68480	.30	65660	.30	57460	.33	49640	.33
20	105760	.28	99480	.28	92800	.28	78220	.33	65060	.33	62380	.33	54590	.37	47160	.37
21	100720	.30	94750	.30	88380	.30	74480	.36	61960	.36	59400	.36	51990	.40	44900	.40
22	96140	.33	90440	.33	84360	.33	71100	.40	59140	.40	56700	.40	49630	.45	42860	.45
23	91960	.36	86510	.36	80700	.36	68020	.44	56570	.44	54240	.44	47470	.49	41000	.49
24	88130	.40	82900	.40	77340	.40	65180	.48	54210	.48	51980	.48	45490	.53	39300	.53
25	84610	.43	79590	.43	74240	.43	62580	.52	52040	.52	49900	.52	43670	.57	37720	.57
26	81350	.47	76530	.47	71380	.47	60160	.56	50040	.56	47980	.56	41990	.62	36280	.62
27	78340	.50	73690	.50	68740	.50	57940	.60	48190	.60	46200	.60	40440	.67	34920	.67
28	75540	.54	71060	.54	66280	.54	55860	.65	46470	.65	44560	.65	38990	.72	33680	.72
29	72940	.58	68610	.58	64000	.58	53940	.70	44870	.70	43020	.70	37650	.77	32520	.77
30	70510	.62	66320	.62	61860	.62	52140	.74	43370	.74	41580	.74	36390	.83	31440	.83
31	68230	.66	64180	.66	59880	.66	50460	.80	41970	.80	40240	.80	35220	.89	30420	.89
32	66100	.70	62180	.70	58000	.70	48880	.85	40660	.85	38980	.85	34120	.94	29460	.94
33	64100	.75	60290	.75	56240	.75	47400	.90	39430	.90	37800	.90	33080	1.00	28580	1.00
34	62210	.80	58520	.80	54580	.80	46000	.96	38270	.96	36700	.96	32110	1.06	27740	1.06
35	60430	.85	56850	.85	53020	.85	44700	1.01	37170	1.01	35640	1.01	31190	1.12	26940	1.12
36	58760	.90	55270	.90	51560	.90	43460	1.07	36140	1.07	34660	1.07	30330	1.19	26200	1.19
38	55660	1.00	52370	1.00	48850	1.00	41170	1.20	34240	1.20	32750	1.20	28690	1.34	24750	1.34
40	52880	1.11	49710	1.11	46400	1.11	39140	1.32	32530	1.32	31150	1.32	27300	1.47	23580	1.47

For safe loads below heavy lines the deflection will be greater than the allowable limit for plaster ceiling. For safe loads above dotted lines standard connections will not be of sufficient strength.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STEEL I-BEAMS

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of beam

D=the deflection in inches under the safe load.

For safe loads and deflections under various systems of loading, see page 26.

Distance between Supports in Ft.	15″ I						12″ I						10″ I			
	60 lbs.	D	50 lbs.	D	42 lbs.	D	50 lbs.	D	40 lbs.	D	31½ lbs.	D	30 lbs.	D	25 lbs.	D
10	86610	.11	68750	.11	62840	.11	53930	.14	47790	.14	38370	.14	28620	.16	26050	.16
11	78740	.13	62500	.13	57120	.13	49030	.17	43440	.17	34880	.17	26020	.20	23680	.20
12	72180	.16	57290	.16	52360	.16	44940	.20	39840	.20	31970	.20	23850	.24	21710	.24
13	66620	.19	52890	.19	48340	.19	41480	.23	36780	.23	29510	.23	22020	.28	20040	.28
14	61860	.22	49110	.22	44880	.22	38520	.27	34160	.27	27400	.27	20450	.32	18610	.32
15	57740	.25	45840	.25	41880	.25	35950	.31	31880	.31	25580	.31	19080	.37	17360	.37
16	54140	.28	42970	.28	39260	.28	33710	.35	29880	.35	23980	.35	17890	.42	16280	.42
17	50940	.32	40440	.32	36960	.32	31720	.40	28120	.40	22570	.40	16840	.48	15320	.48
18	48120	.36	38200	.36	34900	.36	29960	.45	26550	.45	21310	.45	15900	.54	14470	.54
19	45580	.40	36190	.40	33060	.40	28380	.50	25160	.50	20180	.50	15070	.60	13710	.60
20	43300	.44	34380	.44	31420	.44	26960	.55	23900	.55	19180	.55	14310	.66	13020	.66
21	41240	.49	32740	.49	29920	.49	25630	.61	22760	.61	18270	.61	13630	.73	12400	.73
22	39360	.53	31250	.53	28560	.53	24510	.67	21740	.67	17440	.67	13010	.80	11840	.80
23	37660	.58	29890	.58	27320	.58	23450	.73	20780	.73	16680	.73	12450	.88	11320	.88
24	36080	.63	28650	.63	26180	.63	22470	.79	19920	.79	15990	.79	11930	.95	10850	.95
25	34640	.69	27500	.69	25140	.69	21570	.86	19120	.86	15350	.86	11450	1.03	10420	1.03
26	33320	.75	26440	.75	24160	.75	20740	.93	18380	.93	14760	.93	11010	1.12	10020	1.12
27	32080	.80	25460	.80	23280	.80	19970	1.00	17700	1.00	14210	1.00	10600	1.21	9650	1.21
28	30940	.86	24550	.86	22440	.86	19260	1.08	17080	1.08	13700	1.08	10220	1.30	9300	1.30
29	29860	.93	23710	.93	21660	.93	18600	1.16	16480	1.16	13230	1.16	9870	1.39	8980	1.39
30	28860	.99	22920	.99	20940	.99	17980	1.24	15940	1.24	12790	1.24	9540	1.49	8680	1.49
31	27940	1.06	22180	1.06	20260	1.06	17400	1.33	15420	1.33	12380	1.33	.....	....	.....	....
32	27060	1.13	21490	1.13	19640	1.13	16850	1.41	14930	1.41	11990	1.41	.....	....	.....	....
33	26240	1.20	20830	1.20	19040	1.20	16340	1.50	14510	1.50	11630	1.50	.....	....	.....	....
34	25480	1.28	20220	1.28	18480	1.28	15860	1.59	14060	1.59	11280	1.59	.....	....	.....	....
35	24740	1.38	19640	1.38	17960	1.38	15410	1.69	13650	1.69	10950	1.69	.....	....	.....	....
36	24060	1.43	19100	1.43	17460	1.43	14980	1.79	13280	1.79	10660	1.79	.....	....	.....	....

For safe loads below heavy lines the deflection will be greater than the allowable limit for plaster ceiling
For safe loads above dotted lines standard connections will not be of sufficient strength.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STEEL I-BEAMS

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of beam

D=the deflection in inches under the safe load.

For safe loads and deflections under various systems of loading, see page 26.

Distance between Supports in Ft.	9″ I		8″ I		7″ I		6″ I		5″ I		4″ I		3″ I	
	21 lbs.	D	18 lbs.	D	15 lbs.	D	12¼ lbs	D	9¾ lbs.	D	7½ lbs.	D	5½ lbs.	D
2	100660	.004	75850	.005	55200	.01	38750	.01	25800	.01	15900	.02	8800	.02
3	67100	.01	50560	.01	36800	.02	25830	.02	17200	.03	10600	.04	5860	.05
4	50320	.03	37920	.03	27600	.04	19370	.04	12900	.05	7950	.07	4410	.09
5	40320	.05	30330	.05	22080	.06	15490	.07	10320	.08	6360	.10	3530	.14
6	33600	.07	25280	.07	18400	.09	12910	.10	8600	.12	5300	.15	2940	.20
7	28800	.09	21670	.10	15770	.12	11070	.13	7370	.16	4540	.20	2520	.27
8	25160	.12	18960	.13	13800	.15	9680	.18	6450	.21	3980	.26	2210	.35
9	22370	.15	16850	.17	12270	.19	8610	.22	5730	.27	3530	.34	1960	.45
10	20130	.18	15170	.21	11050	.24	7750	.28	5160	.35	3180	.41	1770	.55
11	18300	.22	13790	.25	10040	.29	7040	.33	4690	.40	2890	.50	1600	.67
12	16780	.26	12640	.30	9200	.34	6460	.40	4300	.48	2650	.60	1470	.80
13	15480	.31	11670	.35	8490	.40	5960	.47	3970	.56	2450	.70	1360	.93
14	14380	.36	10830	.41	7890	.46	5530	.54	3680	.65	2270	.81	1260	1.08
15	13420	.41	10110	.47	7360	.53	5160	.62	3440	.75	2120	.93	1180	1.24
16	12580	.47	9480	.53	6900	.60	4840	.71	3220	.85	1990	1.06	1100	1.41
17	11840	.53	8920	.60	6490	.68	4560	.80	3030	.95	1870	1.19	1040	1.59
18	11180	.60	8430	.67	6130	.77	4300	.90	2870	1.07	1770	1.34	980	1.79
19	10600	.66	7980	.75	5810	.85	4080	1.00	2720	1.19	.....	....	.....	....
20	10060	.74	7580	.83	5520	.95	3870	1.10	2580	1.32	.....	....	.....	....
21	9580	.81	7220	.91	5260	1.04	3690	1.21	.....	.....	.....	....	.....	....
22	9160	.89	6890	1.00	5020	1.14	3520	1.33	.....	.....	.....	....	.....	....
23	8760	.97	6590	1.09	4800	1.25	.....	.....	.....	.....	.....	....	.....	....
24	8380	1.06	6320	1.19	4600	1.36	.....	.....	.....	.....	.....	....	.....	....
25	8060	1.15	6070	1.29	.....	.....	.....	.....	.....	.....	.....	....	.....	....
26	7740	1.24	5830	1.40	.....	.....	.....	.....	.....	.....	.....	....	.....	....
27	7460	1.34	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	....
28	7180	1.44	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	....

For safe loads below heavy lines the deflection will be greater than the allowable limit for plaster ceiling.

For safe loads above dotted lines standard connections will not be of sufficient strength.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STANDARD CHANNELS

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of channel

D = the deflection in inches under the safe load.

For safe loads and deflections under various systems of loading, see page 26.

Distance between Supports in Ft.	15″ ⊏						12″ ⊏				10″ ⊏			
	50 lbs.	D	40 lbs.	D	33 lbs.	D	40 lbs.	D	20½ lbs.	D	30 lbs.	D	15 lbs.	D
10	57270	.11	49420	.11	44450	.11	35010	.14	22780	.14	22020	.17	14270	.17
11	52060	.13	44930	.13	40410	.13	31830	.17	20700	.17	20020	.20	12970	.20
12	47720	.16	41190	.16	37040	.16	29180	.20	18980	.20	19350	.24	11890	.24
13	44050	.19	38020	.19	34190	.19	26930	.23	17520	.23	16940	.28	10980	.28
14	40910	.22	35300	.22	31750	.22	25010	.27	16270	.27	15730	.32	10190	.32
15	38180	.26	32950	.26	29630	.26	23340	.31	15180	.31	14680	.37	9510	.37
16	35790	.29	30890	.29	27780	.29	21880	.35	14230	.35	13760	.42	8920	.42
17	33690	.32	29070	.32	26150	.32	20600	.40	13400	.40	12950	.48	8390	.48
18	31820	.36	27460	.36	24700	.36	19450	.45	12650	.45	12240	.54	7930	.54
19	30140	.40	26070	.40	23400	.40	18430	.50	11990	.50	11590	.60	7510	.60
20	28630	.44	24710	.44	22230	.44	17510	.55	11390	.55	11010	.66	7130	.66
21	27270	.49	23540	.49	21170	.49	16670	.61	10850	.61	10490	.73	6790	.73
22	26030	.53	22470	.53	20210	.53	15910	.67	10350	.67	10010	.80	6490	.80
23	24900	.58	21490	.58	19330	.58	15220	.73	9900	.73	9580	.88	6200	.88
24	23860	.69	20590	.64	18520	.64	14590	.79	9490	.79	9 180	.95	5940	.95
25	22910	.69	19770	.69	17780	.69	14000	.85	9110	.85	8 810	1.03	5710	1.03
26	22030	.75	19010	.75	17100	.75	13470	.93	8760	.93	8470	1.12	5490	1.12
27	21210	.81	18310	.81	16460	.81	12970	1.01	8440	1.01	8160	1.21	5280	1.21
28	20450	.86	17650	.86	15880	.88	12500	1.09	8130	1.09	7870	1.30	5100	1.30
29	19750	.93	17040	.93	15330	.93	12070	1.16	7850	1.16	7590	1.39	4920	1.39
30	19090	.99	16470	.99	14820	.99	11670	1.24	7590	1.24	7340	1.49	4760	1.49

For safe loads below heavy lines, the deflection will be greater than the allowable limit for plaster ceilings.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STANDARD CHANNELS

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of channel

D=the deflection in inches under the safe load.

For safe loads and deflections under various systems of loading, see page 26.

Distance between Supports in Ft.	9″ ⊏		8″ ⊏		7″ ⊏		6″ ⊏		5″ ⊏		4″ ⊏		3″ ⊏	
	13¼ lbs.	D	11¼ lbs.	D	9¾ lbs.	D	8 lbs.	D	6½ lbs.	D	5¼ lbs.	D	4 lbs.	D
4	28070	.03	21530	.03	16070	.04	11550	.04	7910	.05	5060	.07	2910	.09
5	22430	.05	17230	.05	12850	.06	9240	.07	6330	.08	4050	.10	2330	.14
6	18690	.07	14360	.07	10710	.09	7700	.10	5270	.12	3370	.15	1940	.20
7	16020	.09	12310	.10	9180	.12	6600	.14	4520	.16	2890	.20	1660	.27
8	14020	.12	10770	.13	8030	.15	5780	.18	3960	.21	2530	.26	1450	.35
9	12460	.15	9570	.17	7140	.19	5130	.22	3520	.27	2250	.34	1290	.45
10	11220	.18	8610	.21	6430	.24	4620	.28	3160	.33	2020	.41	1160	.55
11	10200	.21	7830	.25	5840	.29	4200	.33	2880	.40	1840	.50	1060	.67
12	9350	.26	7180	.30	5360	.34	3850	.40	2640	.48	1690	.59	970	.80
13	8630	.31	6630	.35	4940	.40	3550	.47	2430	.56	1560	.70	890	.93
14	8010	.36	6150	.41	4590	.46	3300	.54	2260	.65	1440	.81	830	1.08
15	7480	.41	5740	.47	4280	.53	3080	.62	2110	.74	1350	.93	780	1.24
16	7010	.47	5380	.53	4020	.61	2890	.71	1980	.85	1260	1.06	730	1.41
17	6600	.53	5070	.60	3780	.68	2720	.79	1860	.96	1190	1.20	680	1.60
18	6230	.60	4790	.67	3570	.77	2570	.89	1760	1.07	1120	1.34	650	1.79
19	5900	.66	4530	.75	3380	.85	2430	1.00	1670	1.20	...	...	...	...
20	5610	.74	4310	.83	3210	.95	2310	1.10	1580	1.32	...	...	...	...
21	5340	.81	4100	.91	3060	1.03	2200	1.22	...	...	...	...	...	...
22	5100	.89	3920	1.01	2920	1.14	2100	1.34	...	...	...	...	...	...
23	4880	.97	3750	1.09	2790	1.25	...	...	...	...	...	...	...	...
24	4670	1.06	3590	1.19	2680	1.36	...	...	...	...	...	...	...	...
25	4490	1.15	3450	1.29	...	...	...	...	...	...	...	...	...	...
26	4320	1.24	...	...	...	...	...	...	...	...	...	...	...	...
27	4160	1.34	...	...	...	...	...	...	...	...	...	...	...	...

For safe loads below heavy lines the deflection will be greater than the allowable limit for plaster ceiling

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR EQUAL LEGGED ANGLES

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of angle

Size	DISTANCE BETWEEN SUPPORTS IN FEET									
	1	2	3	4	5	6	7	8	9	10
6 x 6 x ¾	71040	35520	23680	17760	14210	11840	10150	8880	7890	7100
6 x 6 x ½	49170	24590	16390	12290	9830	8200	7020	6150	5460	4920
6 x 6 x ⅜	37640	18820	12540	9400	7520	6280	5380	4700	4180	3760
5 x 5 x ½	33600	16800	11200	8400	6720	5600	4800	4200	3730	3360
5 x 5 x ⅜	25820	12900	8600	6460	5160	4300	3680	3220	2860	2580
4 x 4 x ½	21010	10510	7000	5250	4200	3500	3000	2630	2340	2100
4 x 4 x ⅜	16210	8110	5400	4050	3240	2700	2320	2030	1800	1620
4 x 4 x 5/16	13760	6880	4580	3440	2760	2300	1960	1720	1520	1380
3½ x 3½ x ⅜	12270	6140	4090	3070	2450	2050	1750	1530	1360	1230
3½ x 3½ x 5/16	10400	5200	3460	2600	2080	1740	1480	1300	1160	1040
3 x 3 x ⅜	8850	4430	2950	2210	1770	1480	1260	1110	980	890
3 x 3 x 5/16	7570	3790	2520	1890	1510	1260	1080	950	840	760
3 x 3 x ¼	6180	3100	2060	1540	1240	1040	880	770	680	620
2½ x 2½ x ⅜	6080	3040	2030	1520	1220	1010	870	760	680	610
2½ x 2½ x 5/16	5120	2560	1710	1280	1020	850	730	640	570	510
2½ x 2½ x ¼	4270	2140	1420	1070	850	710	610	530	470	430
2 x 2 x ¾	3730	1870	1240	930	750	620	530	470	410	370
2 x 2 x 5/16	3200	1600	1070	800	640	530	460	400	360	320
2 x 2 x ¼	2670	1330	890	670	530	450	380	330	300	270
1¾ x 1¾ x ¼	2030	1015	680	510	410	340	290	250	230	200

For lengths to the right of heavy line the deflection will be greater than $\frac{3}{16}$".
For lengths to the right of the dotted line, the deflection will be greater than $\frac{3}{8}$"
For safe loads under various systems of loading, see page 26.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR UNEQUAL LEGGED ANGLES

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of angle

LONG LEG VERTICAL

Size of Angle	DISTANCE BETWEEN SUPPORTS IN FEET									
	1	2	3	4	5	6	7	8	9	10
7 x 3½ x 7/16	53440	26720	17820	13360	10680	8900	7640	6680	5940	5340
6 x 4 x ½	46190	23090	15390	11550	9240	7690	6600	5770	5130	4620
6 x 4 x ⅜	35420	17700	11800	8860	7080	5900	5060	4420	3940	3540
6 x 3½ x ½	45230	22610	15070	11310	9050	7540	6460	5650	5020	4520
6 x 3½ x ⅜	34660	17340	11560	8660	6940	5780	4960	4340	3860	3460
5 x 4 x ½	32540	16270	10840	8140	6500	5420	4650	4070	3610	3250
5 x 4 x ⅜	24960	12480	8320	6240	5000	4160	3560	3120	2770	2500
5 x 3½ x ½	31890	15950	10630	7980	6380	5320	4560	3990	3540	3190
5 x 3½ x ⅜	24430	12210	8140	6110	4890	4070	3490	3050	2710	2440
5 x 3½ x 5/16	20700	10360	6900	5180	4140	3460	2960	2580	2300	2080
5 x 3 x ⅜	23890	11950	7960	5970	4780	3980	3410	2980	2650	2390
5 x 3 x 5/16	20160	10080	6720	5040	4040	3360	2880	2520	2240	2020
4 x 3½ x ⅜	16000	8000	5330	4000	3200	2660	2290	2000	1780	1600
4 x 3½ x 5/16	13440	6720	4480	3360	2680	2240	1920	1680	1500	1340
4 x 3 x ⅜	15570	7790	5190	3890	3110	2590	2220	1950	1730	1560
4 x 3 x 5/16	13120	6560	4380	3280	2620	2200	1880	1640	1460	1320
3½ x 3 x ⅜	12050	6030	4020	3010	2410	2010	1720	1500	1340	1210
3½ x 3 x 5/16	10240	5120	3420	2560	2040	1700	1460	1280	1140	1020
3½ x 2½ x ⅜	11630	5810	3880	2910	2330	1940	1660	1450	1290	1160
3½ x 2½ x ¼	8000	4000	2660	2000	1600	1340	1140	1000	880	800
3 x 2½ x ⅜	8640	4320	2880	2160	1730	1440	1230	1080	960	860
3 x 2½ x ¼	5980	2990	1990	1490	1200	1000	860	740	660	600
3 x 2 x ⅜	8320	4160	2770	2080	1660	1380	1190	1040	920	830
3 x 2 x ¼	5760	2880	1920	1440	1150	960	820	720	640	580
2½ x 2 x ⅜	5870	2930	1960	1470	1170	980	840	730	650	590
2½ x 2 x ¼	4050	2030	1350	1010	810	670	580	500	450	400

For lengths to the right of heavy line the deflection will be greater than 3/16".

For safe loads under various systems of loading, see page 26.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR UNEQUAL LEGGED ANGLES

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of angle

SHORT LEG VERTICAL

Size of Angle	DISTANCE BETWEEN SUPPORTS IN FEET									
	1	2	3	4	5	6	7	8	9	10
7 x 3½ x 7/16	15680	7840	5220	3920	3140	2620	2240	1960	1740	1560
6 x 4 x ½	22180	11090	7390	5540	4430	3690	3160	2770	2460	2220
6 x 4 x ⅜	17060	8540	5680	4260	3420	2840	2440	2140	1900	1700
6 x 3½ x ½	16960	8480	5650	4240	3390	2820	2420	2120	1880	1700
6 x 3½ x ⅜	13120	6560	4380	3280	2620	2180	1880	1640	1460	1320
5 x 4 x ½	21760	10880	7250	5440	4350	3620	3100	2720	2420	2180
5 x 4 x ⅜	16740	8380	5580	4180	3340	2800	2400	2100	1860	1680
5 x 3½ x ½	16640	8320	5550	4160	3320	2770	2380	2080	1850	1660
5 x 3½ x ⅜	12910	6450	4300	3220	2580	2150	1840	1610	1430	1290
5 x 3½ x 5/16	10880	5440	3620	2720	2180	1820	1560	1360	1200	1080
5 x 3 x ⅜	9490	4746	3160	2370	1890	1580	1360	1180	1050	950
5 x 3 x 5/16	8000	4000	2660	2000	1600	1340	1140	1000	880	800
4 x 3½ x ⅜	12590	6290	4190	3150	2520	2090	1800	1570	1400	1260
4 x 3½ x 5/16	10780	5380	3600	2700	2160	1800	1540	1340	1200	1080
4 x 3 x ⅜	9280	4640	3090	2320	1860	1540	1320	1160	1030	920
4 x 3 x 5/16	7900	3940	2640	1980	1580	1320	1120	980	880	780
3½ x 3 x ⅜	9060	4530	3020	2260	1810	1511	1290	1130	1000	900
3½ x 3 x 5/16	7680	3840	2560	1920	1540	1280	1100	960	860	760
3½ x 2½ x ⅜	6290	3140	2090	1570	1260	1050	900	790	690	630
3½ x 2½ x ¼	4380	2180	1460	1100	880	720	620	540	480	440
3 x 2½ x ⅜	6180	3090	2060	1540	1230	1030	880	770	685	620
3 x 2½ x ¼	4260	2140	1420	1060	860	720	600	540	480	420
3 x 2 x ⅜	3950	1970	1320	990	790	660	560	490	440	390
3 x 2 x ¼	2660	1340	880	660	540	440	380	340	300	260
2½ x 2 x ⅜	3840	1920	1280	960	770	640	550	480	420	380
2½ x 2 x ¼	2660	1340	880	660	540	440	380	340	300	260

For lengths to the right of heavy line the deflection will be greater than 3/16″.
For lengths to the right of dotted line the deflection will be greater than 1/8″.
For safe loads under various systems of loading, see page 26.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR STANDARD TEES

Safe loads are figured for a fiber stress of 16000 pounds per square inch, and include the weight of tees

Section Number	Size of Flange by Stem	Weight per Foot	DISTANCE BETWEEN SUPPORTS IN FEET									
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	**5 x 3**	13.6	12580	6300	4200	2140	2520	2100	1800	1580	1400	1260
2	**5 x 2½**	11.	9180	4580	3060	2300	1840	1520	1320	1140	1020	920
3	**4 x 4**	10.9	17500	8740	5840	4380	3500	2920	2500	2180	1940	1740
4	**3½ x 3½**	11.9	16220	8100	5400	4060	3240	2700	2320	2020	1800	1620
4	**3½ x 3½**	9.3	12700	6340	4240	3180	2540	2120	1820	1580	1420	1260
5	**3½ x 3**	11.0	12060	6020	4020	2020	2420	2000	1720	1500	1340	1200
5	**3½ x 3**	8.7	9380	4700	3120	2340	1880	1560	1340	1180	1040	940
6	**3 x 3**	10.1	11740	5860	3920	2940	2340	1960	1680	1460	1300	1180
6	**3 x 3**	6.8	7900	3940	2640	1980	1580	1320	1120	980	880	780
7	**2½ x 2½**	5.6	5340	2660	1780	1340	1060	880	760	660	600	540
8	**2¼ x 2¼**	4.2	3420	1700	1140	860	680	560	.....	.....	.....	.....
9	**2 x 2**	3.7	2660	1340	880	660	540	.....	.....	.....	.....	.....
10	**1¾ x 1¾**	3.2	2020	1020	680	500	400	.....	.....	.....	.....	.....
11	**1½ x 1½**	2.0	1180	580	400	300	.....	.....	.....	.....	.....	.....
12	**1¼ x 1¼**	1.7	740	380	240	180	.....	.....	.....	.....	.....	.....
13	**1 x 1**	1.0	320	160	100	.....	.....	.....	.....	.....	.....	.....

For lengths to the right of heavy lines the deflection will be more than $\frac{3}{16}$" for the given safe loads.
For safe loads under various systems of loading, see page 26.

GENERAL FORMULÆ ON THE FLEXURE OF BEAMS OF ANY CROSS-SECTION

Let A = area of section in square inches.
l = length of span in inches,
W = load uniformly distributed in pounds,
M = bending moment in inch pounds,
h = height of cross section, out to out, in inches,
n = distance of center of gravity of section, from top or from bottom, in inches,
f = stress per square inch in extreme fibers of beam, either top or bottom, in pounds according as n relates to distance from top or from bottom of section,
D = maximum deflection in inches.
I = moment of inertia of section neutral axis through center of gravity,
I'' = moment of inertia of section neutral axis parallel to above, but not through center of gravity,
d = distance between these neutral axes,
S = section modulus,
r = radius of gyration in inches,
E = modulus of elasticity for steel 29,000,000

Then $S = \frac{I}{n}$ $\qquad r = \sqrt{\frac{I}{A}}$

$$M = \frac{f I}{n} = f S,$$

$$f = \frac{M n}{I} = \frac{M}{S},$$

$$W = \frac{8 f I}{l n} = \frac{8 f}{l} S,$$

$$f = \frac{W l n}{8 I} = \frac{W l}{8 S},$$

$$I'' = I + A d^2,$$

$D = \frac{5 W l^3}{384 E I}$ for beam supported at both ends uniformly loaded,

$D = \frac{P l^3}{48 E I}$ for beam supported at both ends and loaded with a single load P at middle.

$D = \frac{W l^3}{8 E I}$ for beam fixed at one end and unsupported at the other and uniformly loaded.

$D = \frac{P l^3}{3 E I}$ for beam fixed at one end and unsupported at other and loaded with a single load P at the latter end.

PROPERTIES OF I-BEAMS.

Depth of Beam Inches	Weight per Foot Pounds	Area of Section Square Inches	Thickness of Web Inches	Width of Flange Inches	Moment of Inertia Neutral Axis Perpendicular to Web at Center I	Moment of Inertia Neutral Axis Coincident with Center line of Web I'	Radius of Gyration Neutral Axis Perpendicular to Web at Center r	Radius of Gyration Neutral Axis Coincident with Center line of Web r'	Section Modulus Neutral Axis Perpendicular to Web at Center S	Coefficient of Strength For Fiber Stress of 16,000 lbs. per Sq. Inch, Used for Buildings C	Coefficient of Strength For Fiber Stress of 12,500 lbs. per Sq. Inch. Used for Bridges C'	Distance Center to Center Required to make Radii of Gyration Equal $I_D^D I$
	100.00	29.41	0.754	7.254	2380.3	48.56	9.00	1.28	198.4	2,115,800	1,653,000	17.82
	95.00	27.94	0.692	7.192	2309.6	47.10	9.09	1.30	192.5	2,052,900	1,603,900	17.99
24	90.00	26.47	0.631	7.131	2239.1	45.70	9.20	1.31	186.6	1,990,300	1,554,900	18.21
	85.00	25.00	0.570	7.070	2168.6	44.35	9.31	1.33	180.7	1,927,600	1,505,900	18.43
	80.00	**23.32**	**0.500**	**7.000**	**2087.9**	**42.86**	**9.46**	**1.36**	**174.0**	**1.855.900**	**1.449.900**	**18.72**
	100.00	29.41	0.884	7.284	1655.8	52.65	7.50	1.34	165.6	1,766,100	1,379,800	14.76
	95.00	27.94	0.810	7.210	1606.8	50.78	7.58	1.35	160.7	1,713,900	1,339,000	14.92
20	90.00	26.47	0.737	7.137	1557.8	48.98	7.67	1.36	155.8	1,661.600	1,298,100	15.10
	85.00	25.00	0.663	7.063	1508.7	47.25	7.77	1.37	150.9	1,609,300	1,257,200	15.30
	80.00	**23.73**	**0.600**	**7.000**	**1466.5**	**45.81**	**7.86**	**1.39**	**146.7**	**1.564.300**	**1.222.100**	**15.47**
	75.00	22.06	0.649	6.399	1268.9	30.25	7.58	1.17	126.9	1,353,500	1,057,400	14.98
20	70.00	20.59	0.575	6.325	1219.9	29.04	7.70	1.19	122.0	1,301,200	1,016,600	15.21
	65.00	**19.08**	**0.500**	**6.250**	**1169.6**	**27.86**	**7.83**	**1.21**	**117.0**	**1.247.600**	**974.700**	**15.47**
	70.00	20.59	0.719	6.259	921.3	24.62	6.69	1.09	102.4	1,091,900	853,000	13.20
	65.00	19.12	0.637	6.177	881.5	23.47	6.79	1.11	97.9	1,044,800	816,200	13.40
18	60.00	17.65	0.555	6.095	841.8	22.38	6.91	1.13	93.5	997,700	779,500	13.63
	55.00	**15.93**	**0.460**	**6.000**	**795,6**	**21.19**	**7.07**	**1.15**	**88.4**	**943.000**	**736.700**	**13.95**
	100.00	29.41	1.184	6.774	900.5	50.98	5.53	1.31	120.1	1,280,700	1,000,600	10.75
	95.00	27.94	1.085	6.675	872 9	48.37	5.59	1.32	116.4	1,241,500	969,900	10.86
15	90.00	26.47	0.987	6.577	845.4	45.91	5.65	1.32	112.7	1,202,300	939,300	10.99
	85.00	25.00	0.889	6.479	817.8	43.57	5.72	1.32	109.0	1,163,000	908,600	11.13
	80.00	**23.81**	**0.810**	**6.400**	**795.5**	**41.76**	**5.78**	**1.32**	**106.1**	**1.131.300**	**883.900**	**11.25**
	75.00	22.06	0.882	6.292	691.2	30.68	5.60	1.18	92.2	983,000	768,000	10.95
	70.00	20.59	0.784	6.194	663.6	29.00	5.68	1.19	88.5	943,800	737,400	11.11
15	65.00	19.12	0.686	6.096	636.0	27.42	5.77	1.20	84.8	904,600	706,700	11.29
	60.00	**17.67**	**0.590**	**6.000**	**609.0**	**25.96**	**5.87**	**1.21**	**81.2**	**866.100**	**676.600**	**11.49**
	55.00	16.18	0.656	5.746	511.0	17.06	5.62	1.02	68.1	726,800	567,800	11.05
	50.00	14.71	0.558	5.648	483.4	16.04	5.73	1.04	64.5	687,500	537,100	11.27
15	45.00	13.24	0.460	5.550	455.8	15.00	5.87	1.07	60.8	648,200	506,400	11.54
	42.00	**12.48**	**0.410**	**5.500**	**441.7**	**14.62**	**5.95**	**1.08**	**58.9**	**628.300**	**490.800**	**11.70**
	55.00	16.18	0.822	5.612	321.0	17.46	4.45	1.04	53.5	570,600	445,800	8.65
	50.00	14.71	0.699	5.489	303.3	16.12	4.54	1.05	50.6	539,200	421,300	8.83
12	45.00	13.24	0.576	5.366	285.7	14 89	4 65	1.06	47.6	507,900	396,800	9.06
	40.00	**11.84**	**0.460**	**5.250**	**268.9**	**13.81**	**4.77**	**1.08**	**44.8**	**478.100**	**373.500**	**9.29**

L = Safe load in pounds uniformly distributed; l = Span in feet.
M′ = Moment of forces in foot pounds; C and C′ = Coefficients given

$$L = \frac{C \text{ or } C'}{l}; \quad M' = \frac{C \text{ or } C'}{8}; \quad C \text{ or } C' = L\,l = 8\,M' = \frac{8\,f\,S}{12}.$$

Weights in heavy print are Standard; others are Special

PROPERTIES OF I-BEAMS

Depth of Beam Inches.	Weight per foot Pounds.	Area of Section Square Inches.	Thickness of Web Inches.	Width of Flange Inches	Moment of Inertia Neutral Axis Perpendicular to Web at Center I	Moment of Inertia Neutral Axis Coincident With Center Line of Web. I'	Radius of Gyration Neutral Axis Perpendicular to Web at Center. r	Radius of Gyration Neutral Axis Coincident With Center Line of Web. r'	Section Modulus Neutral Axis Perpendicular to Web at Center S	Coefficient of Strength for Fiber Stress of 16,000 lbs. per Sq. Inch Used for Buildings. C	Coefficient of Strength for Fiber Strain of 12,500 lbs. per Sq. Inch Used for Bridges. C'	Distance Center to Center Required to Make Radii of Gyration Equal. $\frac{I_P}{M_I}$
12	35.00	10.29	0.436	5.086	228.3	10.07	4.71	0.99	38.0	405,800	317,000	9.21
	31.50	**9.26**	**0.350**	**5.000**	**215.8**	**9.50**	**4.83**	**1.01**	**36.0**	**383,700**	**299,700**	**9.45**
10	40.00	11.76	0.749	5.099	158.7	9.50	3.67	0.90	31.7	338,500	264,500	7.12
	35.00	10.29	0.602	4.952	146.4	8.52	3.77	0.91	29.3	312,400	244,100	7.32
	30.00	8.82	0.455	4.805	134.2	7.65	3.90	0.93	26.8	286,300	223,600	7.57
	25.00	**7.37**	**0.310**	**4.660**	**122.1**	**6.89**	**4.07**	**0.97**	**24.4**	**260,500**	**203,500**	**7.91**
9	35.00	10.29	0.732	4.772	111.8	7.31	3.29	0.84	24.8	265,000	207,000	6.36
	30.00	8.82	0.569	4.609	101.9	6.42	3.40	0.85	22.6	241,500	188,700	7.58
	25.00	7.35	0.406	4.446	91.9	5.65	3.54	0.88	20.4	217,900	170,300	6.86
	21.00	**6.31**	**0.290**	**4.330**	**84.9**	**5.16**	**3.67**	**0.90**	**18.9**	**201,300**	**157,300**	**7.12**
8	25.50	7.50	0.541	4.271	68.4	4.75	3.02	0.80	17.1	182,500	142,600	5.82
	23.00	6.76	0.449	4.179	64.5	4.39	3.09	0.81	16.1	172,000	134,400	5.96
	20.50	6.03	0.357	4.087	60.6	4.07	3.17	0.82	15.1	161,600	126,200	6.12
	18.00	**5.33**	**0.270**	**4.000**	**56.9**	**3.78**	**3.27**	**0.84**	**14.2**	**151,700**	**118,500**	**6.32**
7	20.00	5.88	0.458	3.868	42.2	3.24	2.68	0.74	12.1	128,600	100,400	5.15
	17.50	5.15	0.353	3.763	39.2	2.94	2.76	0.76	11.2	119,400	93,300	5.31
	15.00	**4.42**	**0.250**	**3.660**	**36.2**	**2.67**	**2.86**	**0.78**	**10.4**	**110,400**	**86,300**	**5.50**
6	17.25	5.07	0.475	3.575	26.2	2.36	2.27	0.68	8.7	93,100	72,800	4.33
	14.75	4.34	0.352	3.452	24.0	2.09	2.35	0.69	8.0	85,300	66,600	4.49
	12.25	**3.61**	**0.230**	**3.330**	**21.8**	**1.85**	**2.46**	**0.72**	**7.3**	**77,500**	**60,500**	**4.70**
5	14.75	4.34	0.504	3.294	15.2	1.70	1.87	0.63	6.1	64,600	50,500	
	12.25	3.60	0.357	3.147	13.6	1.45	1.94	0.63	5.4	58,100	45,400	
	9.75	**2.87**	**0.210**	**3.000**	**12.1**	**1.23**	**2.05**	**0.65**	**4.8**	**51,600**	**40,300**	
4	10.50	3.09	0.410	2.880	7.1	1.01	1.52	0.57	3.6	38,100	29,800	
	9.50	2.79	0.337	2.807	6.7	0.93	1.55	0.58	3.4	36,000	28,100	
	8.50	2.50	0.263	2.733	6.4	0.85	1.59	0.58	3.2	33,900	26,500	
	7.50	**2.21**	**0.190**	**2.660**	**6.0**	**0.77**	**1.64**	**0.59**	**3.0**	**31,800**	**24,900**	
3	7.50	2.21	0.361	2.521	2.9	0.60	1.15	0.52	1.9	20,700	16,200	
	6.50	1.91	0.263	2.423	2.7	0.53	1.19	0.52	1.8	19,100	15,000	
	5.50	**1.63**	**0.170**	**2.330**	**2.5**	**0.46**	**1.23**	**0.53**	**1.7**	**17,600**	**13,800**	

L = Safe load in pounds uniformly distributed; l = Span in feet.
M = Moment of forces in foot pounds; C and C′ = Coefficients given.

$$L = \frac{C \text{ or } C'}{l}; \quad M' = \frac{C \text{ or } C'}{8}; \quad C \text{ or } C' = L\,l = 8M' = \frac{8\,f\,s}{12}.$$

Weights in heavy print are standard : others are special.

PROPERTIES OF CHANNELS.

Depth of Channel Inches.	Weight per Foot Pounds.	Area of Section Square Inches	Thickness of Web Inches.	Width of Flange Inches.	Moment of Inertia Neutral Axis Perpendicular to Web at Center. I	Moment of Inertia Neutral Axis Parallel With Center Line of Web. I'	Radius of Gyration Neutral Axis Perpendicular to Web at Center. r	Radius of Gyration Neutral Axis Parallel With Center Line of Web. r'	Section Modulus Neutral Axis Perpendicular to Web at Center. S	Coefficient of Strength for Fiber Stress of 16,000 lbs. Per Sq. Inch Used for Building. C	Coefficient of Strength for Fiber Stress of 12,500 lbs. per Sq. Inch Used for Bridges. C'	Distance Required to Make Radii of Gyration Equal. $\frac{D}{2}$	Distance of Center of Gravity from Outside of Web. X
	55.00	16.18	0.818	3.818	430.2	12.19	5.16	0.868	57.4	611,900	478,000	8.53	0.823
	50.00	14.71	0.720	3.720	402.7	11.22	5.23	0.873	53.7	572,700	447,400	8.71	0.803
15	45.00	13.24	0.622	3.622	375·1	10.29	5.32	0.882	50.0	533,500	416,800	8.92	0.788
	40.00	11.76	0.524	3.524	347.5	9.39	5.43	0.893	46.3	494,200	386,100	9.15	0.783
	35.00	10.29	0.426	3.426	320.0	8.48	5.58	0.908	42.7	455,000	355,500	9.43	0.789
	33.00	**9.90**	**0.400**	**3.400**	**312.6**	**8.23**	**5.62**	**0.912**	**41.7**	**444,500**	**347,300**	**9.50**	**0.794**
	40.00	11.76	0.758	3.418	197.0	6.63	4.09	0.751	32.8	350,200	273,600	6.60	0.722
	35.00	10.29	0.636	3.296	179.3	5.90	4.17	0.757	29.9	318,800	249,100	6.81	0.694
12	30.00	8.82	0.513	3.173	161.7	5.21	4.28	0.768	26.9	287,400	224,500	7.07	0.677
	25.00	7.35	0.390	3.050	144.0	4.53	4.43	0 785	24.0	256,100	200,000	7.36	0.678
	20.50	**6.03**	**0.280**	**2.940**	**128.1**	**3.91**	**4.61**	**0.805**	**21.4**	**227,800**	**178,000**	**7.67**	**0.704**
	35.00	10.29	0.823	3.183	115.5	4.66	3.35	0.672	23.1	246,400	192,500	5.17	0.695
	30.00	8.82	0.676	3.036	103.2	3.90	3.42	0.672	20.6	220,300	172,100	5.40	0.651
10	25.00	7.35	0.529	2.889	91.0	3.40	3.52	0.680	18.2	194,100	151,700	5.67	0.620
	20.00	5.88	0.382	2.742	78.7	2.85	3.66	0.696	15.7	168,000	131,200	5.97	0.609
	15.00	**4.46**	**0.240**	**2.600**	**66.9**	**2.30**	**3.87**	**0.718**	**13.4**	**142,700**	**111,500**	**6.33**	**0.639**
	25.00	7.35	0.615	2.815	70.7	2.98	3.10	0.637	15.7	167,600	130,900	4.84	0.615
9	20.00	5.88	0.452	2.652	60.8	2.45	3.21	0.646	13.5	144,100	112,600	5.12	0.585
	15.00	4.41	0.288	2.488	50.9	1.95	3.40	0.665	11.3	120,500	.94,200	5.49	0.590
	13.25	**3.89**	**0.230**	**2.430**	**47.3**	**1.77**	**3.49**	**0.674**	**10.5**	**112,200**	**87,600**	**5.63**	**0.607**
	21.25	6.25	0.582	2.622	47.8	2.25	2.77	0.600	11.9	127,400	99,500	4.23	0.587
	18.75	5.51	0.490	2.530	43.8	2.01	2.82	0.603	11.0	116,900	91,300	4.38	0.567
8	16.25	4.78	0.399	2.439	39.9	1.78	2.89	0.610	10.0	106,400	83,200	4.54	0.556
	13.75	4.04	0.307	2.347	36.0	1.55	2.98	0.619	9.0	96,000	75,000	4.72	0.557
	11.25	**3.35**	**0.220**	**2.260**	**32.3**	**1.33**	**3.11**	**0.630**	**8.1**	**86,100**	**67,300**	**4.94**	**0.576**
	19.75	5.81	0.633	2.513	33.2	1.85	2.39	0.565	9.5	101,100	79,000	3.48	0.583
	17.25	5.07	0.528	2.408	30.2	1.62	2.44	0.564	8.6	92,000	71,800	3.64	0.555
7	14.75	4.34	0.423	2.303	27.2	1.40	2.50	0.568	7.8	82,800	64,700	3.80	0.535
	12.25	3.60	0.318	2.198	24.2	1.19	2.59	0.575	6.9	73,700	57,500	3.99	0.528
	9.75	**2.85**	**0.210**	**2.090**	**21.1**	**0.98**	**2.72**	**0.586**	**6.0**	**66,800**	**52,200**	**4.22**	**0.546**
	15.50	4.56	0.563	2.283	19.5	1.28	2.07	0.529	6.5	69,500	54,300	2.91	0.546
6	13.00	3.82	0.440	2.160	17.3	1.07	2.13	0.529	5.8	61,600	48,100	3.09	0.517
	10 50	3.09	0·318	2.038	15.1	0.88	2.21	0.534	5.0	53,800	42,000	3.28	0.503
	8.00	**2.38**	**0.200**	**1.920**	**13.0**	**0.70**	**2.34**	**0.542**	**4.3**	**46,200**	**36,100**	**3.52**	**0.517**
	11.50	3.38	0.477	2.037	10.4	0.82	1.75	0.493	4.2	44,400	34,700	2.34	0.508
5	9.00	2.65	0.330	1.890	8.9	0.64	1.83	0.493	3.5	37,900	29,600	2 56	0.481
	6.50	**1.95**	**0.190**	**1.750**	**7.4**	**0.48**	**1.95**	**0.498**	**3.0**	**31,600**	**24,700**	**2.79**	**0.489**
	7.25	2.13	0.325	1.725	4.6	0.44	1.46	0.455	2.3	24,400	19,000	1.85	0.463
4	6.25	1.84	0.252	1.652	4.2	0.38	1.51	0.454	2.1	22,300	17,400	1.96	0.458
	5.25	**1.55**	**0.180**	**1.580**	**3.8**	**0.32**	**1.56**	**0.453**	**1.9**	**20,200**	**15,800**	**2.06**	**0.464**
	6.00	1.76	0.362	1.602	2.1	0.31	1.08	0.421	1.4	14,700	11,500	1.07	0.459
3	5.00	1.47	0.264	1.504	1.8	0.25	1.12	0.415	1.2	13,100	10,300	1.19	0.443
	4.00	1.19	0.170	1.410	1.6	0.20	1.17	0.409	1.1	11,600	9,100	1.31	0.443

PROPERTIES OF ANGLES WITH UNEQUAL LEGS.

Size.	Thickness	Weight per Lin. Foot	Area of Section.	Perpendicular Distances from Center of Gravity to Back of Flange.		Moments of Inertia. *I*		Section Moduli. *S*		Radii of Gyration. *r*		
				To Back of Long Flange.	To back of Short Flange.	Neutral Axis Parallel to Long Flange.	Neutral Axis Parallel to Short Flange.	Neutral Axis Parallel to Long Flange	Neutral Axis Parallel to Short Flange.	Neutral Axis Parallel to Long Flange.	Neutral Axis Parallel to Short Flange.	Least Radius.
Inches	Inches	Lbs.	Sq. In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
8 x 3 ½	11/20	20.5	6.02	0.75	3.00	4.92	39.96	1.79	7.99	0. 90	2.58	0.74
7 x 3 ½	1	32.3	9.50	0.96	2.71	7.53	45.37	2.96	10.58	0.89	2.19	0.88
7 x 3 ½	15/16	30.5	8.97	0.94	2.69	7.18	43.13	2.80	10.00	0.89	2.19	0.88
7 x 3 ½	7/8	28.7	8.42	0.92	2.67	6.83	40.82	2.64	9.42	0.90	2.20	0.88
7 x 3 ½	13/16	26.8	7.87	0.89	2.64	6.46	38.45	2.48	8.82	0.91	2.21	0.88
7 x 3 ½	3/4	24 9	7.31	0.87	2.62	6.08	35.99	2.31	8.22	0.91	2.22	0.88
7 x 3 ½	11/16	23.0	6.75	0.85	2.60	5.69	33.47	2.14	7.60	0.92	2.23	0.89
7 x 3 ½	5/8	21.0	6.17	0.82	2.57	5.28	30.86	1.97	6.97	0.93	2.24	0.89
7 x 3 ½	9/16	19.1	5.59	0.80	2.55	4.86	28.18	1.80	6.33	0.93	2.25	0.89
7 x 3 ½	1/2	17.0	5.00	0.78	2.53	4.41	25.41	1.62	5.68	0.94	2.25	0.89
7 x 3 ½	7/16	15.0	4.40	0.75	2.50	3.95	22.56	1.47	5.01	0.95	2.26	0.89
6 x 4	1	30.6	9.00	1.17	2.17	10.75	30.75	3.79	8.02	1.09	1.85	0.85
6 x 4	15/16	28.9	8.50	1.14	2.14	10.26	29.26	3.59	7.59	1.10	1.86	0.85
6 x 4	7/8	27.2	7.99	1.12	2.12	9.75	27.73	3.39	7.15	1.11	1.86	0.86
6 x 4	13/16	25.4	7.47	1.10	2.10	9.23	26.15	3.18	6.70	1.11	1.87	0.86
6 x 4	3/4	23.6	6.94	1.08	2.08	8.68	24.51	2.97	6.25	1.12	1.88	0.86
6 x 4	11/16	21.8	6.41	1.06	2.06	8.11	22.82	2.76	5.78	1.13	1.89	0.86
6 x 4	5/8	20.0	5.86	1.03	2.03	7.52	21.07	2.54	5.31	1.13	1.90	0.86
6 x 4	9/16	18.1	5.31	1.01	2.01	6.91	19.26	2.31	4.83	1.14	1.90	0.87
6 x 4	1/2	16.2	4.75	0.99	1.99	6.27	17.40	2.08	4.33	1.15	1.91	0.87
6 x 4	7/16	14.3	4.18	0.96	1.96	5.60	15.46	1.85	3.83	1.16	1.92	0.87
6 x 4	3/8	12.3	3.61	0.94	1.94	4.90	13.47	1.60	3.32	1.17	1.93	0.88
6 x 3 ½	1	28.9	8.50	1.01	2.26	7.21	29.24	2.90	7.83	0.92	1.85	0.74
6 x 3 ½	15/16	27.3	8.03	0.99	2.24	6.88	27.84	2.74	7.41	0.93	1.86	0.74
6 x 3 ½	7/8	25.7	7.55	0.97	2.22	6.55	26.38	2.59	6.98	0.93	1.87	0.75
6 x 3 ½	13/16	24.0	7.06	0.95	2.20	6.20	24.89	2.43	6.55	0.94	1.88	0.75
6 x 3 ½	3/4	22.4	6.56	0.93	2.18	5.84	23.34	2.27	6.10	0.94	1.89	0.75
6 x 3 ½	11/16	20.6	6.06	0.90	2.15	5.47	21.74	2.11	5.65	0.95	1.89	0.75
6 x 3 ½	5/8	18.9	5.55	0.88	2.13	5.08	20.08	1.94	5.19	0.96	1.90	0.75
6 x 3 ½	9/16	17.1	5.03	0.86	2.11	4.67	18.37	1.77	4.72	0.96	1.91	0.75
6 x 3 ½	1/2	15.3	4.50	0.83	2.08	4.25	16.59	1.59	4.24	0.97	1.92	0.76
6 x 3 ½	7/16	13.5	3.97	0.81	2.06	3.81	14.76	1.41	3.75	0.98	1.93	0.76
6 x 3 ½	3/8	11.7	3.42	0.79	2.04	3.34	12.86	1.23	3.25	0.99	1.94	0.77
5 x 4	7/8	24.2	7.11	1.21	1.71	9.23	16.42	3.31	4.99	1.14	1.52	0.84
5 x 4	13/16	22.7	6.65	1.18	1.68	8.74	15.54	3.11	4.69	1.15	1.53	0.84
5 x 4	3/4	21.1	6.19	1.16	1.66	8.23	14.60	2.90	4.37	1.15	1.54	0.84
5 x 4	11/16	19.5	5.72	1.14	1.64	7.70	13.62	2.69	4.05	1.16	1.54	0.84
5 x 4	5/8	17.8	5.23	1.12	1.62	7.14	12.61	2.48	3.73	1.17	1.55	0.84
5 x 4	9/16	16.2	4.75	1.10	1.60	6.56	11.55	2.26	3.39	1.18	1.56	0.85
5 x 4	1/2	14.5	4.25	1.07	1.57	5.96	10.46	2.04	3.05	1.18	1.57	0.85
5 x 4	7/16	12.8	3.75	1.05	1.55	5.32	9.32	1.81	2.70	1.19	1.58	0.85
5 x 4	3/8	11.0	3.23	1.03	1.53	4.67	8.14	1.57	2.34	1.20	1.59	0.86

PROPERTIES OF ANGLES WITH UNEQUAL LEGS.

Size.	Thickness.	Weight per Lin. Foot.	Area of Section.	Perpendicular Distances from Center of Gravity to Back of Flange.		Moments of Inertia. *I*		Section Moduli. *S*		Radii of Gyration. *r*		
				To back of Long Flange.	To Back of Short Flange.	Neutral Axis Parallel to Long Flange.	Neutral Axis Parallel to Short Flange.	Neutral Axis Parallel to Long Flange.	Neutral Axis Parallel to Short Flange.	Neutral Axis Parallel to Long Flange.	Neutral Axis Parallel to Short Flange.	Least Radius
Inches.	Inches.	Lbs.	Sq. In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
5 x 3 1/2	7/8	22.7	6.67	1.04	1.79	6.21	15.67	2.52	4.88	0.96	1.53	0.75
5 x 3 1/2	13/16	21.3	6.25	1.02	1.77	5.89	14.81	2.37	4.58	0.97	1.54	0.75
5 x 3 1/2	3/4	19.8	5.81	1.00	1.75	5.55	13.92	2.22	4.28	0.98	1.55	0.75
5 x 3 1/2	11/16	18.3	5.37	0.97	1.72	5.20	12.99	2.06	3.97	0.98	1.56	0.75
5 x 3 1/2	5/8	16.8	4.92	0.95	1.70	4.83	12.03	1.90	3.65	0.99	1.56	0.75
5 x 3 1/2	9/16	15.2	4.47	0.93	1.68	4.45	11.03	1.73	3.32	1.00	1.57	0.75
5 x 3 1/2	1/2	13.6	4.00	0.91	1.66	4.05	9.99	1.56	2.99	1.01	1.58	0.75
5 x 3 1/2	7/16	12.0	3.53	0.88	1.63	3.63	8.90	1.39	2.64	1.01	1.59	0.76
5 x 3 1/2	3/8	10.4	3.05	0.86	1.61	3.18	7.78	1.21	2.29	1.02	1.60	0.76
5 x 3 1/2	5/16	8.7	2.56	0.84	1.59	2.72	6.60	1.02	1.94	1.03	1.61	0.76
5 x 3	13/16	19.9	5.84	0.86	1.86	3.71	13.98	1.74	4.45	0.80	1.55	0.64
5 x 3	3/4	18.5	5.44	0.84	1.84	3.51	13.15	1.63	4.16	0.80	1.55	0.64
5 x 3	11/16	17.1	5.03	0.82	1.82	3.29	12.28	1.51	3.86	0.81	1.56	0.64
5 x 3	5/8	15.7	4.61	0.80	1.80	3.06	11.37	1.39	3.55	0.82	1.57	0.64
5 x 3	9/16	14.3	4.18	0.77	1.77	2.83	10.43	1.27	3.23	0.82	1.58	0.65
5 x 3	1/2	12.8	3.75	0.75	1.75	2.58	9.45	1.15	2.91	0.83	1.59	0.65
5 x 3	7/16	11.3	3.31	0.73	1.73	2.32	8.43	1.02	2.58	0.84	1.60	0.65
5 x 3	3/8	9.8	2.86	0.70	1.70	2.04	7.37	0.89	2.24	0.84	1.61	0.65
5 x 3	5/16	8.2	2.40	0.68	1.68	1.75	6.26	0.75	1.89	0.85	1.61	0.66
4 x 3 1/2	13/16	18.5	5.43	1.11	1.36	5.49	7.77	2.30	2.92	1.01	1.19	0.72
4 x 3 1/2	3/4	17.3	5.06	1.09	1.34	5.18	7.32	2.15	2.75	1.01	1.20	0.72
4 x 3 1/2	11/16	16.0	4.68	1.07	1.32	4.86	6.86	2.00	2.56	1.02	1.21	0.72
4 x 3 1/2	5/8	14.7	4.30	1.04	1.29	4.52	6.37	1.84	2.35	1.03	1.22	0.72
4 x 3 1/2	9/16	13.3	3.90	1.02	1.27	4.17	5.86	1.68	2.15	1.03	1.23	0.72
4 x 3 1/2	1/2	11.9	3.50	1.00	1.25	3.79	5.32	1.52	1.93	1.04	1.23	0.72
4 x 3 1/2	7/16	10.6	3.09	0.98	1.23	3.40	4.76	1.35	1.72	1.05	1.24	0.72
4 x 3 1/2	3/8	9.1	2.67	0.96	1.21	2.99	4.18	1.18	1.50	1.06	1.25	0.73
4 x 3 1/2	5/16	7.7	2.25	0.93	1.18	2.59	3.56	1.01	1.26	1.07	1.26	0.73
4 x 3	13/16	17.1	5.03	0.94	1.44	3.47	7.34	1.68	2.87	0.83	1.21	0.64
4 x 3	3/4	16.0	4.69	0.92	1.42	3.28	6.93	1.57	2.68	0.84	1.22	0.64
4 x 3	11/16	14.8	4.34	0.89	1.39	3.08	6.49	1.46	2.49	0.84	1.22	0.64
4 x 3	5/8	13.6	3.98	0.87	1.37	2.87	6.03	1.35	2.30	0.85	1.23	0.64
4 x 3	9/16	12.4	3.62	0.85	1.35	2.66	5.55	1.23	2.09	0.86	1.24	0.64
4 x 3	1/2	11.1	3.25	0.83	1.33	2.42	5.05	1.12	1.89	0.86	1.25	0.64
4 x 3	7/16	9.8	2.87	0.80	1.30	2.18	4.52	0.99	1.68	0.87	1.25	0.64
4 x 3	3/8	8.5	2.48	0.78	1.28	1.92	3.96	0.87	1.46	0.88	1.26	0.64
4 x 3	5/16	7.2	2.09	0.76	1.26	1.65	3.38	0.74	1.23	0.89	1.27	0.65

PROPERTIES OF ANGLES WITH UNEQUAL LEGS.

Size	Thickness	Weight per Lin. Foot	Area of Section	Perpendicular Distances from Center of Gravity to Back of Flange		Moments of Inertia *I*		Section Moduli *S*		Radii of Gyration *r*		
				To Back of Long Flange	To Back of Short Flange	Neutral Axis Parallel to Long Flange	Neutral Axis Parallel to Short Flange	Neutral Axis Parallel to Long Flange	Neutral Axis Parallel to Short Flange	Neutral Axis Parallel to Long Flange	Neutral Axis Parallel to Short Flange	Least Radius
Inches	In.	Lbs.	Sq.In	In.	In.	In.	In.	In.	In.	In.	In.	In.
3 1/2 x 3	13/16	15.8	4.62	0.98	1.23	3.33	4.98	1.65	2.20	0.85	1.04	0.62
3 1/2 x 3	3/4	14.7	4.31	0.96	1.21	3.15	4.70	1.54	2.05	0.85	1.04	0.62
3 1/2 x 3	11/16	13.6	4.00	0.94	1.19	2.96	4.41	1.44	1.91	0.86	1.05	0.62
3 1/2 x 3	5/8	12.5	3.67	0.92	1.17	2.76	4.11	1.33	1.76	0.87	1.06	0.62
3 1/2 x 3	9/16	11.4	3.34	0.90	1.15	2.55	3.79	1.21	1.61	0.87	1.07	0.62
3 1/2 x 3	1/2	10.2	3.00	0.88	1.13	2.33	3.45	1.10	1.45	0.88	1.07	0.62
3 1/2 x 3	7/16	9.1	2.65	0.85	1.10	2.09	3.10	0.98	1.29	0.89	1.08	0.62
3 1/2 x 3	3/8	7.9	2.30	0.83	1.08	1.85	2.72	0.85	1.13	0.90	1.09	0.62
3 1/2 x 3	5/16	6.6	1.93	0.81	1.06	1.58	2.33	0.72	0.96	0.90	1.10	0.63
3 1/2 x 2 1/2	11/16	12.5	3.65	0.77	1.27	1.72	4.13	0.99	1.85	0.67	1.06	0.53
3 1/2 x 2 1/2	5/8	11.5	3.36	0.75	1.25	1.61	3.85	0.92	1.71	0.69	1.07	0.53
3 1/2 x 2 1/2	9/16	10.4	3.06	0.73	1.23	1.49	3.55	0.84	1.56	0.70	1.08	0.53
3 1/2 x 2 1/2	1/2	9.4	2.75	0.70	1.20	1.36	3.24	0.76	1.41	0.70	1.09	0.53
3 1/2 x 2 1/2	7/16	8.3	2.43	0.68	1.18	1.23	2.91	0.68	1.26	0.71	1.09	0.54
3 1/2 x 2 1/2	3/8	7.2	2.11	0.66	1.16	1.09	2.56	0.59	1.09	0.72	1.10	0.54
3 1/2 x 2 1/2	5/16	6.1	1.78	0.64	1.14	0.94	2.19	0.50	0.93	0.73	1.11	0.54
3 1/2 x 2 1/2	1/4	4.9	1.44	0.61	1.11	0.78	1.80	0.41	0.75	0.74	1.12	0.54
3 x 2 1/2	9/16	9.5	2.78	0.77	1.02	1.42	2.28	0.82	1.15	0.72	0.91	0.52
3 x 2 1/2	1/2	8.5	2.50	0.75	1.00	1.30	2.08	0.74	1.04	0.72	0.91	0.52
3 x 2 1/2	7/16	7.6	2.22	0.73	0.98	1.18	1.88	0.66	0.93	0.73	0.92	0.52
3 x 2 1/2	3/8	6.6	1.92	0.71	0.96	1.04	1.66	0.58	0.81	0.74	0.93	0.52
3 x 2 1/2	5/16	5.6	1.62	0.68	0.93	0.90	1.42	0.49	0.69	0.74	0.94	0.53
3 x 2 1/2	1/4	4.5	1.31	0.66	0.91	0.74	1.17	0.40	0.56	0.75	0.95	0.53
3 x 2	1/2	7.7	2.25	0.58	1.08	0.67	1.92	0.47	1.00	0.55	0.92	0.43
3 x 2	7/16	6.8	2.00	0.56	1.06	0.61	1.73	0.42	0.89	0.55	0.93	0.43
3 x 2	3/8	5.9	1.73	0.54	1.04	0.54	1.53	0.37	0.78	0.56	0.94	0.43
3 x 2	5/16	5.0	1.47	0.52	1.02	0.47	1.32	0.32	0.66	0.57	0.95	0.43
3 x 2	1/4	4.1	1.19	0.49	0.99	0.39	1.09	0.25	0.54	0.57	0.95	0.43
2 1/2 x 2	1/2	6.8	2.00	0.63	0.88	0.64	1.14	0.46	0.70	0.56	0.75	0.42
2 1/2 x 2	7/16	6.1	1.78	0.60	0.85	0.58	1.03	0.41	0.62	0.57	0.76	0.42
2 1/2 x 2	3/8	5.3	1.55	0.58	0.83	0.51	0.91	0.36	0.55	0.58	0.77	0.42
2 1/2 x 2	5/16	4.5	1.31	0.56	0.81	0.45	0.79	0.31	0.47	0.58	0.78	0.42
2 1/2 x 2	1/4	3.7	1.06	0.54	0.79	0.37	0.65	0.25	0.38	0.59	0.78	0.42
2 1/2 x 2	3/16	2.8	0.81	0.51	0.76	0.29	0.51	0.20	0.29	0.60	0.79	0.43
2 x 1 3/4	1/4	2.7	0.78	0.37	0.69	0.12	0.37	0.12	0.23	0.39	0.63	0.30
2 x 1 3/8	3/16	2.1	0.60	0.35	0.66	0.09	0.24	0.09	0.18	0.40	0.63	0.31

PROPERTIES OF ANGLES WITH EQUAL LEGS.

SIZE Inches.	Thickness. Inches.	Weight per Foot Pounds.	Area of Section Sq. Inches.	Distance of Center of Gravity from back of Flange Inches.	Moment of Inertia. Neutral Axis through Center of Gravity parallel to Flange. *I*	Section Modulus. Neutral Axis as before. *S*	Radius of Gyration. Neutral Axis as before. *r*	Least Radius of Gyration. Neutral Axis through Center of Gravity at Angle of 45 Degrees to Flanges. *r'*
8 x 8	1 1/8	56.9	16.73	2.41	97.97	17.53	2.42	1.55
8 x 8	1 1/16	54.0	15.87	2.39	93.53	16.67	2.43	1.56
8 x 8	1	51.0	15.00	2.37	88.98	15.80	2.44	1.56
8 x 8	15/16	48.1	14.12	2.34	84.33	14.91	2.44	1.56
8 x 8	1/8	45.0	13.23	2.32	79.58	14.01	2.45	1.57
8 x 8	13/16	42.0	12.34	2.30	74.71	13.11	2.46	1.57
8 x 8	3/4	38.9	11.44	2.28	69.74	12.18	2.47	1.57
8 x 8	11/16	35.8	10.53	2.25	64.64	11.25	2.48	1.58
8 x 8	5/8	32.7	9.61	2.23	59.42	10.30	2.49	1.58
8 x 8	9/16	29.6	8.68	2.21	54.09	9.34	2.50	1.58
8 x 8	1/2	26.4	7.75	2.19	48.63	8.37	2.50	1.58
6 x 6	1	37.4	11.00	1.86	35.46	8.57	1.80	1.16
6 x 6	15/16	35.3	10.37	1.84	33.72	8.11	1.80	1.16
6 x 6	7/8	33.1	9.74	1.82	31.92	7.64	1.81	1.17
6 x 6	13/16	31.0	9.09	1.80	30.06	7.15	1.82	1.17
6 x 6	3/4	28.7	8.44	1.78	28.15	6.66	1.83	1.17
6 x 6	11/16	26.5	7.78	1.75	26.19	6.17	1.83	1.17
6 x 6	5/8	24.2	7.11	1.73	24.16	5.66	1.84	1.18
6 x 6	9/16	21.9	6.43	1.71	22.07	5.14	1.85	1.18
6 x 6	1/2	19.6	5.75	1.68	19.91	4.61	1.86	1.18
6 x 6	7/16	17.2	5.06	1.66	17.68	4.07	1.87	1.19
6 x 6	3/8	14.9	4.36	1.64	15.39	3.53	1.88	1.19
5 x 5	1	30.6	9.00	1.61	19.64	5.80	1.48	0.96
5 x 5	15/16	28.9	8.50	1.59	18.71	5.49	1.48	0.96
5 x 5	7/8	27.2	7.99	1.57	17.75	5.17	1.49	0.96
5 x 5	13/16	25.4	7.46	1.55	16.77	4.85	1.50	0.97
5 x 5	3/4	23.6	6.94	1.52	15.74	4.53	1.51	0.97
5 x 5	11/16	21.8	6.42	1.50	14.68	4.20	1.51	0.97
5 x 5	5/8	20.0	5.86	1.48	13.58	3.86	1.52	0.97
5 x 5	9/16	18.1	5.31	1.46	12.44	3.51	1.53	0.98
5 x 5	1/2	16.2	4.75	1.43	11.25	3.15	1.54	0.98
5 x 5	7/16	14.3	4.18	1.41	10.02	2.79	1.55	0.98
5 x 5	3/8	12.3	3.61	1.39	8.74	2.42	1.56	0.99
4 x 4	13/16	19.9	5.84	1.29	8.14	3.01	1.18	0.77
4 x 4	3/4	18.5	5.44	1.27	7.67	2.81	1.19	0.77
4 x 4	11/16	17.1	5.03	1.25	7.17	2.61	1.19	0.77
4 x 4	5/8	15.7	4.61	1.23	6.66	2.40	1.20	0.77
4 x 4	9/16	14.3	4.18	1.21	6.12	2.19	1.21	0.78
4 x 4	1/2	12.8	3.75	1.18	5.56	1.97	1.22	0.78
4 x 4	7/16	11.3	3.31	1.16	4.97	1.75	1.23	0.78
4 x 4	3/8	9.8	2.86	1.14	4.36	1.52	1.23	0.79
4 x 4	5/16	8.2	2.40	1.12	3.71	1.29	1.24	0.79

PROPERTIES OF ANGLES WITH EQUAL LEGS

SIZE Inches.	Thickness Inches	Weight per Foot Pounds.	Area of Section. Square Inches.	Distance of Center of Gravity from back of Flange. Inches.	Moment of Inertia, Neutral Axis through Center of Gravity Parallel to Flange. I	Section Modulus, Neutral Axis as before. S	Radius of Gyration. Neutral Axis as Before. r	Least Radius of Gyration. Neutral Axis through Center of Gravity at Angle of 45° to Flanges. r'
3 1/2 x 3 1/2	13/16	17.1	5.03	1.17	5.25	2.25	1.02	0.67
3 1/2 x 3 1/2	3/4	16.0	4.69	1.15	4.96	2.11	1.03	0.67
3 1/2 x 3 1/2	11/16	14.8	4.34	1.12	4.65	1.96	1.04	0.67
3 1/2 x 3 1/2	5/8	13.6	3.98	1.10	4 33	1.81	1.04	0.67
3 1/2 x 3 1/2	9/16	12.4	3.62	1.08	3.99	1.65	1.05	0.68
3 1/2 x 3 1/2	1/2	11.1	3.25	1.06	3.64	1.49	1.06	0.68
3 1/2 x 3 1/2	7/16	9.8	2.87	1.04	3.26	1.32	1.07	0.68
3 1/2 x 3 1/2	3/8	8.5	2.48	1.01	2.87	1.15	1.07	0.69
3 1/2 x 3 1/2	5/16	7.2	2.09	0.99	2.45	0.98	1.08	0.69
3 x 3	5/8	11.5	3.36	0.98	2.62	1.30	0.88	0.57
3 x 3	9/16	10.4	3.06	0.95	2.43	1.19	0.89	0.58
3 x 3	1/2	9.4	2.75	0.93	2.22	1.07	0.90	0.58
3 x 3	7/16	8.3	2.43	0.91	1.99	0.95	0.91	0.58
3 x 3	3/8	7.2	2.11	0.89	1.76	0.83	0.91	0.58
3 x 3	5/16	6.1	1.78	0.87	1.51	0.71	0.92	0.59
3 x 3	1/4	4.9	1.44	0.84	1.24	0.58	0.93	0.59
2 1/2 x 2 1/2	1/2	7.7	2.25	0.81	1.23	0.73	0.74	0.47
2 1/2 x 2 1/2	7/16	6.8	2.00	0.78	1.11	0.65	0.74	0.48
2 1/2 x 2 1/2	3/8	5.9	1.73	0.76	0.98	0.57	0.75	0.48
2 1/2 x 2 1/2	5/16	5.0	1.47	0.74	0.85	0.48	0.76	0.49
2 1/2 x 2 1/2	1/4	4.1	1.19	0.72	0.70	0.40	0.77	0.49
2 1/2 x 2 1/2	3/16	3.1	0.90	0.69	0.55	0.30	0.78	0.49
2 1/4 x 2 1/4	1/2	6.8	2.00	0.74	0.87	0.58	0.66	0.43
2 1/4 x 2 1/4	7/16	6.1	1.78	0.72	0.79	0.52	0.67	0.43
2 1/4 x 2 1/4	3/8	5.3	1.55	0.70	0.70	0.45	0.67	0.43
2 1/4 x 2 1/4	5/16	4.5	1.31	0.68	0.61	0.39	0.68	0.44
2 1/4 x 2 1/4	1/4	3.7	1.06	0.66	0.51	0.32	0.69	0.44
2 1/4 x 2 1/4	3/16	2.8	0.81	0.63	0.39	0.24	0.70	0.44
2 x 2	7/16	5.3	1.56	0.66	0.54	0.40	0.59	0.39
2 x 2	3/8	4.7	1.36	0.64	0.48	0.35	0.59	0.39
2 x 2	5/16	4.0	1.15	0.61	0.42	0.30	0.60	0.39
2 x 2	1/4	3.2	0.94	0.59	0.35	0.25	0.61	0.39
2 x 2	3/16	2.5	0.72	0.57	0.28	0.19	0.62	0.40
1 3/4 x 1 3/4	7/16	4.6	1.30	0.59	0.35	0.30	0.51	0.33
1 3/4 x 1 3/4	3/8	4.0	1.17	0.57	0.31	0.26	0.51	0.34
1 3/4 x 1 3/4	5/16	3.4	1.00	0.55	0.27	0.23	0.52	0.34
1 3/4 x 1 3/4	1/4	2.8	0.81	0.53	0.23	0.19	0.53	0.34
1 3/4 x 1 3/4	3/16	2.2	0.62	0.51	0.18	0.14	0.54	0.35
1 1/2 x 1 1/2	3/8	3.4	0.99	0.51	0.19	0.19	0.44	0.29
1 1/2 x 1 1/2	5/16	2.9	0.84	0.49	0.16	0.162	0.44	0.29
1 1/2 x 1 1/2	1/4	2.4	0.69	0.47	0.14	0.134	0.45	0.29
1 1/2 x 1 1/2	3/16	1.8	0.53	0.44	0.11	0.104	0.46	0.29
1 1/2 x 1 1/2	1/8	1.3	0.36	0.42	0.08	0.070	0.46	0.30

TYPICAL DETAILS

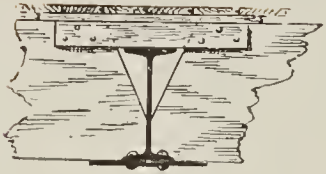


Fig. No. 1

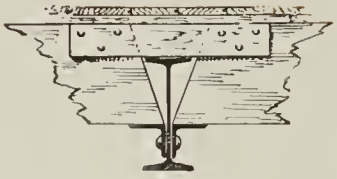


Fig. No. 2

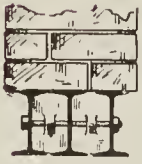


Fig. No. 3

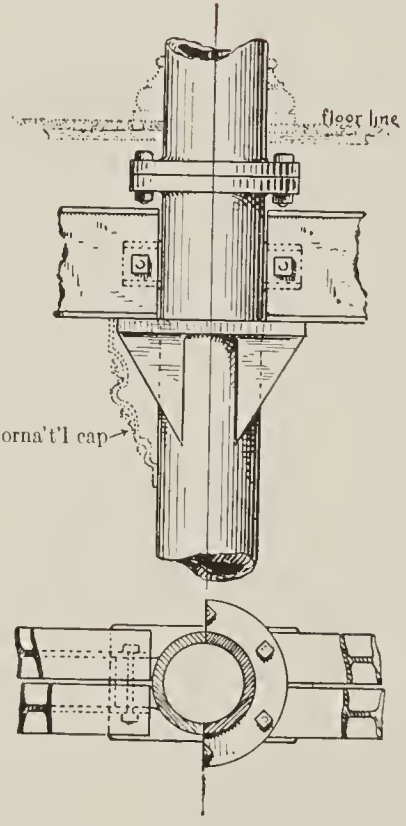


Fig. No. 7

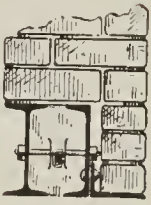


Fig. No. 4

Fig. No. 5

Fig. No. 6

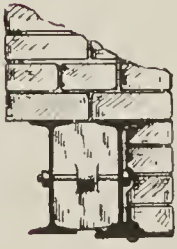


Fig. No. 8

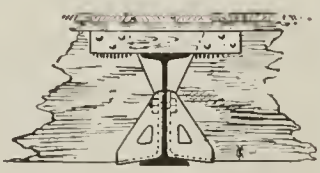


Fig. No. 9

TYPICAL DETAILS, BEAMS AND BEAM ANCHORS

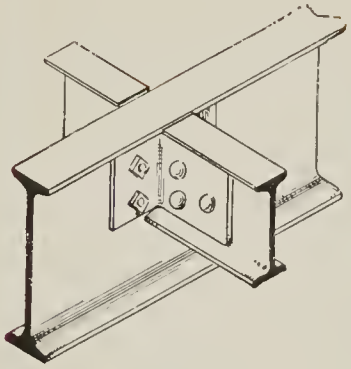


Fig. 11

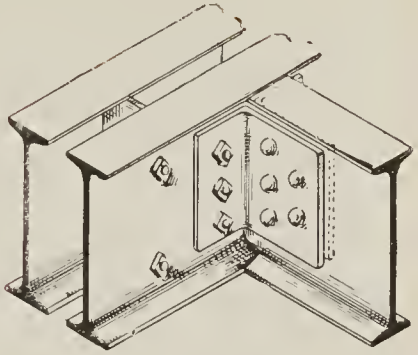


Fig. 12

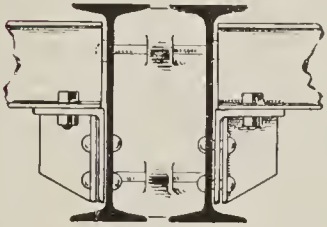


Fig. 13

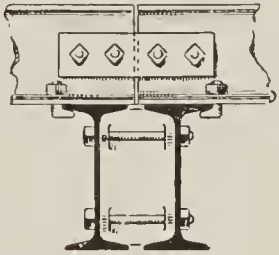


Fig. 14

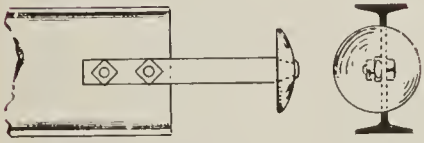


Fig. 15

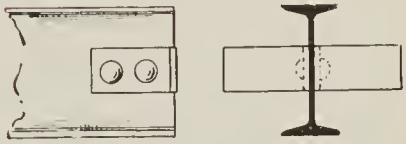


Fig. 16

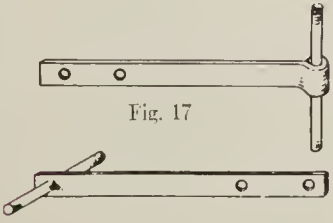


Fig. 17

Fig. 19

Fig. 18

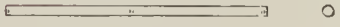


Fig. 20

TYPICAL DETAILS STEEL COLUMNS

Fig. 21

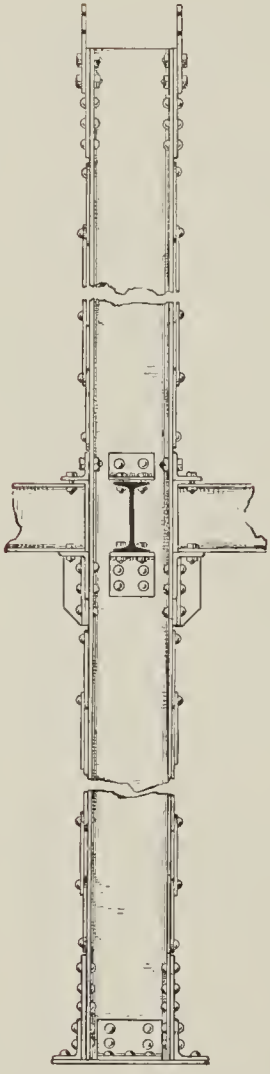
Fig. 22

Fig. 23

Fig. 24

Fig. 25

Fig. 26



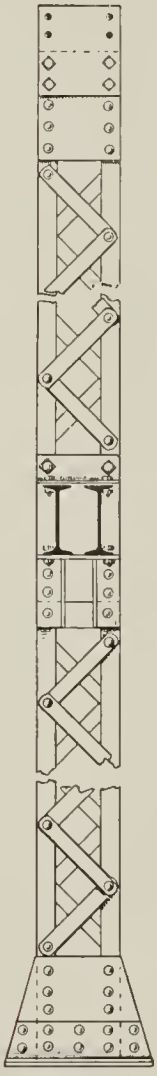


Fig. 27

NOTES ON WOOD FLOORS

The common type of wood floors used for store buildings, small office buildings, etc., where the loads are not heavy consists of joists placed transversely, supported by girders of steel or wood.

Methods of supporting wood joists on steel girders are shown on page 46. The method shown in Fig. 2 may be used where girders are not concealed. Where a flush ceiling is desired, a plate as shown in Fig. 1, or duplex hangers as shown in Fig. 9, may be used without notching the joists.

Mill or slow-burning construction is used for storehouses, mill buildings, etc., where heavy loads must be carried. These floors are constructed of beams placed from 4 to 8 feet on centers and covered with plank from 2 to 3½ inches thick, on top of which is laid the finished floor.

Safe loads for wood beams and posts are given on pages 94 and 95.

Details of connections of wood beams to cast iron columns are illustrated in Fig. 33, page 156, and on the same page will be found details of steel and cast iron post caps and bases.

Several types of joist hangers are in use for framing around stair and wall openings. On page 177, Figs. 49, 50, 51, we have illustrated the single and double stirrup and the Duplex hanger. We carry Duplex and Van Dorn hangers in stock, and are prepared to fill orders promptly.

We have shown in Figs. 52 and 53, page 177, our stock joist and strap anchor; special anchors made to order.

WEIGHTS OF WOOD FLOORS IN POUNDS PER SQUARE FOOT

Spacing of Joists	DIMENSIONS OF JOISTS					
	2 x 10	**2 x 12**	**2 x 14**	**3 x 12**	**3 x 14**	**3 x 16**
12	22	22	23	24	26	27
14	21	22	22	24	25	26
16	21	21	22	23	24	25
18	20	21	21	22	23	24

Based on white pine joist at 2½ lbs. per board foot, 1 thickness of ⅞-inch white pine flooring at 2½ lbs. per square foot, and 1 thickness of ⅞-inch hardwood flooring, at 4 lbs. per board foot.

When no ceiling is used, deduct 12 lbs.

FIREPROOF FLOORS

Fireproof floors are constructed with a framework of steel beams and girders, the spaces between the beams being filled with fireproofing, which consists of arches of brick or hollow tile, or concrete steel in the form of arches or slabs.

Brick arches leveled with concrete are used with a spacing of from 4 feet to 6 feet, or more, provided that the arch is suitably stiffened with concrete against failure from a concentrated load, and that the beams are of sufficient depth to allow a rise of $\frac{1}{10}$ of the span. Floors of this type weigh, including filling and steel beams, from 75 pounds per square foot up.

Several types of tile arches are in common use, the tiles being hollow blocks of dense or porous structure made to form a flat arch. The webs of these blocks are either parallel with the floor beams or perpendicular thereto, the systems being termed side or end construction, respectively. Floors of this type will weigh from 70 to 90 pounds per square foot, including filling and steel beams.

Tie rods to take the thrust of the arches are required for both brick and tile construction. These are $\frac{3}{4}$ or $\frac{7}{8}$ inches in diameter, placed at or below the center of the beam, and from 4 to 6 feet apart.

Floors of concrete re-enforced with steel wire, rods, tees, channels, expanded metal or wire netting are in successful use. Particulars as to their weight and construction can be obtained from the manufacturers. As ordinarily constructed they weigh somewhat less than tile floors.

Examples of steel joists and girders and their connections are illustrated on page 47 Figs. 11 to 14, inclusive. The more common types of beam anchors are shown on the same page, Figs. 15 to 20, inclusive.

Following are the working loads in common use for buildings:

LOADS PER SQUARE FOOT

Dwellings, apartment houses, hotels, etc.	70	lbs.
Offices—first floor, 150 lbs.; above first floor	75	"
Schools	75 to 100	"
Buildings for public assembly.	125 " 150	"
Light storage or manufacturing	120 " 150	"
Stores, warehouses, etc	150 " 250	"
Sidewalks over areas	300	"

NOTE.—To the above loads the dead weight of floor must be added to obtain the total load.

WEIGHTS OF FIREPROOF MATERIAL.

END CONSTRUCTION FLAT ARCHES.

Width of Span between Beams	Depth of Arch	Weight per Square Foot
5 feet to 6 feet	8 inches	27 pounds
6 " " 7 "	9 "	29 "
7 " " 8 "	10 "	33 "
8 " " 9 "	12 "	38 "

SIDE CONSTRUCTION FLAT ARCHES.

Width of Span between Beams	Depth of Arch	Weight per Square Foot
3 feet 6 inches to 4 feet 0 inches	6 inches	27 pounds
4 " 0 " " 4 " 6 "	7 "	29 "
4 " 6 " " 5 " 0 "	8 "	32 "
5 " 6 " " 6 " 0 "	9 "	36 "
6 " 0 " " 6 " 6 "	10 "	39 "
6 " 6 " " 7 " 0 "	12 "	44 "

PARTITIONS.

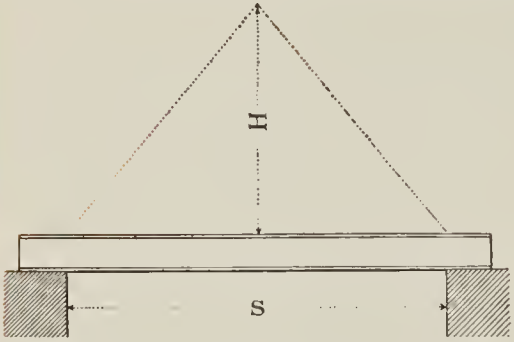
	Thickness	Weight per Square Foot
Hollow Brick (Clay) Partitions	2 inches	11 pounds
" " " "	3 "	14 "
" " " "	4 "	15 "
" " " "	5 "	19 "
" " " "	6 "	20 "
" " " "	8 "	27 "
Porous Terra Cotta Partitions	3 "	16 "
" " " "	4 "	19 "
" " " "	5 "	22 "
" " " "	6 "	23 "
" " " "	8 "	33 "

FURRING, ROOFING AND CEILING.

	Thickness	Weight per Square Foot
Porous Terra Cotta Furring	2 inches	8 pounds
" " " Roofing	2 "	12 "
" " " "	3 "	15 "
" " " "	4 "	19 "
" " " Ceiling	2 "	11 "
" " " "	3 "	15 "
" " " "	4 "	19 "

6 inch Segmental Arches, 27 pounds per square foot.
8 " " " 33 " " " " "
2 inch Porous Terra Cotta Partition, 8 pounds per square foot.

BEAMS SUPPORTING BRICK WALLS



H = S — then
load = ½ (S)² × weight per foot of wall

The method illustrated above may be used for openings 6 feet in width or less, provided there are no openings above, which, by a failure in the masonry, might cause the concentration of a heavy load on the girder.

For larger openings different conditions prevail. If the masonry is not thoroughly bonded, if there is danger of failure along a series of openings one above another, or if great inflexibility is desired it is good practice to consider the weight of entire wall as carried by the girder.

A girder running the entire length of a structure should be figured to support the entire wall above, as excessive deflection might push out the supports and cause the structure to fail.

Where heavy loads are carried, it is best to use columns of steel or cast iron for supports, for masonry, as ordinarily constructed, will fail by crushing out under heavy concentrated loads. When the wall carries any portion of the floor load, same should be added to weight of wall to ascertain the entire load carried by the girder.

Figures 3, 4, 6, 8, page 46, show various types of steel lintels in common use, and their supporting capacity may be obtained from tables of safe loads on pages 28 to 36, inclusive.

A table of safe loads of cast-iron lintels is given on page 153.

Weights of brick walls per square foot of surface:

Thickness of Wall, inches	Common Brick, pounds
12	**112**
16	**150**
20	**188**
24	**224**
28	**262**
32	**300**
36	**336**

NOTES ON GIRDERS AND COLUMNS

Riveted girders are used where the load to be carried exceeds the capacity of single I-beams, or girders composed of two or more I-beams, with separators and bolts.

The tables for beam box girders on pages 54 and 55, are figured from the moments of inertia with the holes in flanges deducted, using a fiber stress of 15,000 pounds per square inch of net section. Beam box girders are especially adapted for short spans and for supporting wide walls.

Where beam box girders are of insufficient strength or where their width prohibits their use, riveted girders composed of plates and angles may be used. The tables on pages 56, 57, 58, 59, give the safe loads, uniformly distributed, for several sections.

Girders with single webs will be found more economical than those with double webs, except for long spans where the girder is not stiffened laterally.

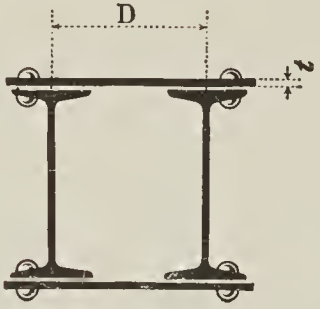
The values given in the tables should not be used for lengths over 20 times the flange width, unless the girder is stiffened laterally.

Stiffeners should be provided to prevent buckling of the web and at all points where concentrated loads occur.

The tables of safe loads for steel columns, pages 60 to 67, inclusive, are based on a fiber stress of 12,500 pounds per square inch, reduced by Gordon's formula. It is assumed that the columns are symmetrically loaded; where eccentrically loaded the values given will be considerably reduced, and should be specially calculated.

Details of a latticed channel column are shown on page 48, Fig. 27, and various sections used for steel columns are illustrated in Figs. 21 to 26, inclusive.

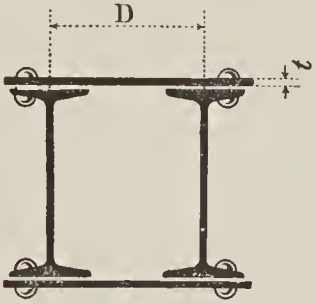
SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS



The safe loads below are based on the moment of inertia of the net section, using a maximum fiber stress of 15000 lbs. per square inch, and include weight of girder. The net section is obtained by deducting holes figured at 7/8 of an inch in diameter for 3/4 inch rivets from both flanges.

Depth of I in Inches	Weight of one I in lbs. per Foot	Width of Cover	Thickness, t	Distance Center to Center of Beams D	LENGTH IN FEET				
					16	18	20	22	24
12	**31½**	12	½	6	74100	65800	59300	53900	49400
12	**40**	12	½	5¾	83100	73900	66500	60500	55400
12	**50**	14	½	7½	97300	86500	77800	70700	64900
15	**42**	14	½	7¾	117700	104600	94100	85600	78500
15	**60**	14	⅝	7¼	153900	136800	123100	111900	102600
15	**50**	14	⅝	7½	137600	122300	110100	100100	91700
18	**55**	16	¾	8¼	211100	187600	168900	153500	140700
18	**70**	16	¾	8	227200	202000	181800	165300	151500
20	**65**	16	¾	8	255100	230000	204000	185500	170000
20	**70**	16	¾	8	260900	231900	208700	189700	173900
20	**80**	16	¾	7¾	287500	255500	230000	209100	191700
24	**80**	18	¾	9½	368400	327400	294700	267900	245600
24	**100**	18	¾	9½	397000	352900	317600	288700	264700

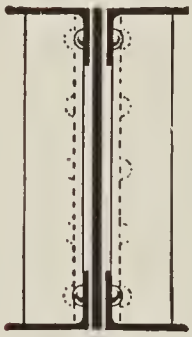
SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS

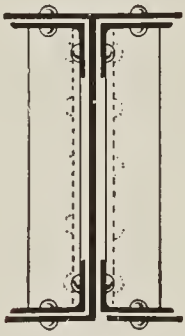


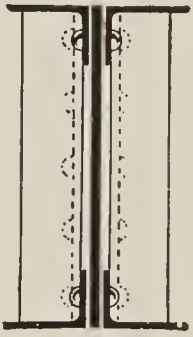
The safe loads below are based on the moment of inertia of the net section, using a maximum fiber stress of 15000 lbs. per square inch, and include weight of girder. The net section is obtained by deducting holes figured at $\frac{7}{8}$ of an inch in diameter for $\frac{3}{4}$ inch rivets from both flanges.

LENGTH IN FEET								Depth of I in Inches
26	**28**	**30**	**32**	**34**	**36**	**38**	**40**	
45600	42300	39500	37000	34900	32900	31200	29600	**12**
51200	47500	44400	41600	39100	37000	35000	33300	**12**
59900	55600	51900	48600	45800	43200	41000	38900	**12**
72400	67200	62800	58800	55400	52300	49500	47100	**15**
94700	87900	82100	77000	72400	68400	64800	61600	**15**
84700	78600	73400	68800	64700	61100	57900	55000	**15**
129900	120600	112600	105600	99300	93800	88900	84400	**18**
139800	129800	121200	113600	106900	101000	95700	90900	**18**
156900	145700	136000	127500	120000	113400	107400	102000	**20**
160300	149100	139100	130400	122800	115900	109800	104400	**20**
177000	164300	153400	143800	135300	127800	121100	115000	**20**
226700	210500	196400	184200	173300	163700	155100	147300	**24**
244300	226900	211700	198500	186800	176400	167200	158800	**24**

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR PLATE GIRDERS



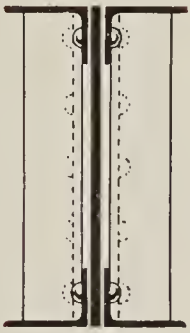


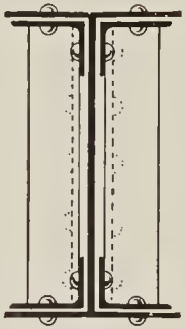


Distance Center to Center of Bearings	Web **30** x 5/16″ Flanges 4 Ls 5 x 3½″ — Thickness of Flange Angles in Inches				Web **30** x 3/8″ Flanges 4 Ls 5 x 3½″ — Thickness of Flange Angles in Inches		Web **30** x 3/8″ Flanges 4 Ls 5 x 3½″ 2 Plates 12″ Wide — Th'kness of Flange Angles and Plates in Inches		Web **36** x 5/16″ Flanges 4 Ls 5 x 3½″ — Thickness of Flange Angles in Inches		Web **36** x 3/8″ Flanges 4 Ls 5 x 3½″ — Thickness of Flange Angles in Inches
	5/16″	3/8″	7/16″	½″	3/8″	½″	3/8″	½″	3/8″	½″	5/8″
20	64900	76800	88900	100300	125700	165700	93200	121700	149100		
21	61800	73300	84700	95600	119700	157700	88800	115900	142000		
22	58900	69900	80800	91200	114300	150600	84700	110600	135500		
23	56400	66800	77300	87200	109300	144100	81100	105800	129600		
24	54000	64000	74100	83600	104760	138100	77700	101400	124200		
25	51900	61500	71200	80300	100600	132500	74600	97300	119200		
26	49900	59100	68400	77200	96700	127400	71700	93600	114600		
27	48000	56900	65900	74400	93100	122700	69100	90100	110400		
28	46300	54900	63500	71700	89800	118300	66600	86900	106400		
29	44700	53300	61300	69200	86700	114300	64300	83800	102800		
30	43200	51200	59300	66900	83800	110500	62200	81100	99300		
31	41800	49600	57400	64800	81100	105900	60200	78600	96200		
32	40500	48000	55600	62800	78600	103600	58300	76100	93200		
33	39300	46600	53900	60900	76200	100400	56500	73800	90400		
34	38100	45200	52400	59000	73900	97500	54900	71400	87700		
35	37100	43900	50900	57400	71800	94700	53300	69600	85200		
36	36000	42700	49500	55800	69800	92000	51800	67700	82800		
37	35100	41500	48100	54200	67900	89600	50400	65900	80500		
38	34100	40400	46900	52900	66200	87200	49100	64100	78400		
39	33300	39400	45700	51500	64500	84900	47900	62500	76500		
40	32400	38400	44500	50200	62900	82800	46700	60900	74500		

The safe loads above are figured for a fiber stress of 15000 lbs. per square inch on the net section, and include the weight of the girder. The net section is obtained by deducting holes figured at 7/8 of an inch in diameter for 3/4 inch rivets from both flanges.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR PLATE GIRDERS

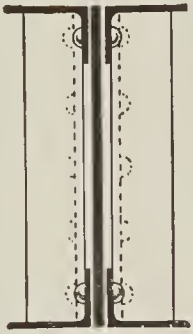


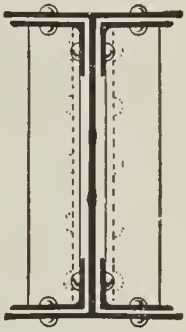


Distance Center to Center of Bearings	Web **36** x 5/16″ Flanges 4 Ls 6 x 4″		Web **36** x 3/8″ Flanges 4 Ls 6 x 4″	Web **36** x 3/8″ Flanges 4 Ls 6 x 6″ 2 Plates 14″ Wide			Web **36** x 1/2″ Flanges 4 Ls 6 x 6″ 2 Plates 14″ Wide
	Thickness of Flange Angles in Inches			Thickness of Flange Angles and Plates in Inches			
	3/8″	1/2″	5/8″	3/8″	7/16″	1/2″	5/8″
20	111900	146700	180000	204400	238100	270400	335300
21	105500	139700	171600	194700	226700	257500	319400
22	101600	133400	163800	185800	216400	245800	304800
23	97200	127500	156700	177700	207000	235100	291600
24	93200	122000	150200	170300	198400	225300	279500
25	89400	117400	144200	163500	190500	216300	268300
26	86000	112900	138600	157200	183100	208000	258000
27	82800	108700	133500	151400	176100	200300	248400
28	79800	104800	128700	146000	170100	193100	239500
29	77100	101200	124300	140900	164200	186500	231300
30	74500	97800	120100	136300	158700	180300	223500
31	72100	94700	116300	131900	153600	174400	216300
32	69900	91700	112600	127700	148800	169000	209600
33	67800	88900	109200	123900	144300	163800	203200
34	65700	86300	106000	120200	140100	159100	197000
35	63900	83800	103000	116800	136000	154500	191400
36	62100	81500	100100	113600	132300	150200	186300
37	60400	79300	97400	110500	128700	146000	181200
38	58800	77200	94800	107600	125300	142300	176500
39	57300	75300	92400	104800	122100	138700	172000
40	55900	73400	90100	102200	119000	135200	167700

The safe loads above are figured for a fiber stress of 15000 lbs. per square inch on the net section, and include the weight of the girder. The net section is obtained by deducting holes figured at 7/8 of an inch in diameter for 3/4-inch rivets from both flanges.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR PLATE GIRDERS



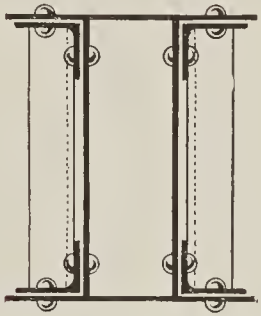


Distance Center to Center of Bearings	Web **42** x ⅜″ Flanges 4 Ls 6 x 4″			Web **42** x ⅜″ Flanges 4 Ls 6 x 6″			Web **42** x ⅜″ Flanges 4 Ls 6 x 6″ 2 Plates 14″ Wide		Web **42** x ½″ Flanges 4 Ls 6 x 6″ 2 Plates 14″ Wide
	Thickness of Flange Angles in Inches						Thickness of Flange Angles and Plates in Inches		
	⅜″	½″	⅝″	⅜″	½″	⅝″	⅜″	½″	⅝″
20	131500	172500	212300	156060	205300	252900	240400	318000	394500
21	125300	164300	202200	148600	195500	240800	228900	302800	375700
22	119600	156800	193000	141800	186600	229900	218500	289100	358600
23	114400	149600	184000	135700	178500	219900	209000	276500	343000
24	109600	143700	176900	130000	171000	210700	200300	264900	328700
25	105300	137900	169800	124800	164200	202300	192300	253200	315600
26	101200	132600	163300	120000	157900	194500	184900	244600	303400
27	97500	127700	157200	115600	152000	187300	178100	235500	291100
28	93900	123200	151600	111400	146600	180600	171100	227100	281800
29	90700	118900	146400	107600	141500	174400	165800	219300	272000
30	87700	115000	141500	104000	136800	168600	160300	212000	263000
31	84900	111300	136900	100700	132300	163100	155100	205100	254500
32	82200	107800	132700	97500	125200	158000	150200	198700	246500
33	79700	104500	128600	94600	142400	153200	145700	192700	239100
34	77400	101500	124900	91800	120700	148700	141400	187100	232000
35	75200	98600	121300	89200	117300	144500	137400	181700	225000
36	73100	95800	117900	86700	114000	140500	133500	176600	219200
37	71200	93200	114700	84400	110900	136700	129900	171900	213200
38	69200	90800	111700	82100	108000	133100	126500	167400	207600
39	67500	88400	108800	80000	105200	129700	123300	163160	202300
40	65800	86200	106100	78000	102600	126400	120200	159000	197200

The safe loads above are figured for a fiber stress of 15000 lbs. per square inch on the net section, and include the weight of the girder.

The net section is obtained by deducting holes figured at ⅞ of an inch in diameter for ¾-inch rivets from both flanges.

SAFE LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR BOX GIRDERS



Webs	3/8" x 30"	7/16" x 36"	1/2" x 30"	3/8" x 36"	7/16" x 36"	1/2" x 36"
Flange Angles	3½"x3½"x3/8"	3½"x3½"x½"	4" x 4" x ½"	4" x 3½" x 3/8"	4" x 3½" x ½"	5" x 4" x ½"
Cover Plates	16" x 3/8"	16" x ½"	16" x ½"	24" x 3/8"	24" x ½"	24" x ½"
Distance Center to Center of Bearings						
20	174800	222200	242700	284600	364400	400100
21	166500	211600	231100	271000	347100	381100
22	158900	202000	220600	258700	331300	363800
23	152000	193200	211000	247500	316900	347900
24	145600	185200	202200	237200	303700	333400
25	139800	177800	194100	227700	291500	320100
26	134400	170800	186700	218900	280300	307800
27	129400	164600	179800	210800	270000	296400
28	124800	158700	173300	203300	260300	285800
29	120500	153200	167400	196300	251300	275900
30	116500	148100	161800	189700	242900	266800
31	112800	143400	156600	183600	235000	258200
32	109200	138900	151700	177900	227800	250100
33	105900	134700	147100	172700	220900	242500
34	102900	130700	142800	167400	214400	235300
35	99900	127000	138700	162600	208200	228600
36	97100	123400	134800	158100	202500	222300
37	94500	120100	131200	153800	197000	216300
38	92000	117000	127700	149800	191800	210600
39	89600	113900	124500	145900	186900	205200
40	87400	111100	121300	142300	182200	200100

The safe loads above are based on the moment of inertia of the net section using a maximum fiber stress of 15000 lbs. per square inch, and include weight of girder. The net section is obtained by deducting holes figured at 7/8 of an inch in diameter (for 3/4" rivets) from both flanges and webs.

SAFE LOADS IN POUNDS

SQUARE ENDS

FOR LATTICED CHANNEL COLUMNS

Based on Gordon's Formula $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$ Factor of safety 4.

Size of ⊏s	**6″** 8 lbs.	**7″** 9¾ lbs.	**8″** 11¼ lbs.	**9″** 13¼ lbs.	**10″** 15 lbs.	**12″** 20½ lbs.	**15″** 33 lbs.
Area of Section. .	4.76	5.70	6.70	7.78	8.92	12.06	19.80
Least Radius of Gyration	2.34	2.72	3.11	3.45	3.84	4.61	5.59
Distance Back to Back	3.625	4.325	5.00	5.50	6.25	7.75	9.50
Length in feet							
8	57000	69000	82000	95000	110000	149000	246000
9	56000	68100	81000	94000	109000	148000	245000
10	55000	68000	80000	94000	109000	148000	244000
11	55000	67000	79600	93400	108000	147000	243000
12	54000	66000	79000	93000	107000	147000	243000
13	53000	65000	78000	92000	106000	146000	242000
14	52000	65000	77000	91000	106000	146000	241000
15	51000	64000	76000	90500	105000	145000	240000
16	50000	63000	76000	90000	104000	144000	240000
17	49000	62000	75000	89000	103000	143000	238000
18	48000	61000	74000	88000	102000	142000	238000
19	47000	59000	73000	87000	101000	141000	236000
20	46000	58000	72000	86000	101000	140000	235000
21	45000	57000	71000	85000	100000	139000	234000
22	44000	56000	70000	84000	99000	138000	233000
23	43000	55000	69000	83000	98000	137000	232000
24	42000	54000	68000	82000	97000	136000	230000
25	41000	53000	66000	81000	96000	135000	229000
26	.....	52000	65000	80000	95000	134000	228000
28	.....	.....	63000	77000	93000	131000	225000
30	.....	.....	61000	75000	90000	129000	222000
32	.....	.....	.....	73000	87000	127000	219000
34	.....	.....	.....	71000	85000	124000	215000
36	.....	.....	.....	.....	83000	121000	213000
40	.....	.....	.....	.....	.....	116000	206000
42	.....	.....	.....	.....	.....	113000	202000

For 6 inch Channel Columns use lacing $1\frac{1}{2} \times \frac{5}{16}$. Rivets $\frac{5}{8}$.
For 7 inch " " " " $1\frac{3}{4} \times \frac{5}{16}$. " $\frac{5}{8}$.
For 8 and 9 inch " " " " 2 $\times \frac{5}{16}$. " $\frac{3}{4}$.
For 10 and 12 inch " " " " 2 $\times \frac{3}{8}$.
For 15 inch " " " " $2\frac{1}{2} \times \frac{3}{8}$.

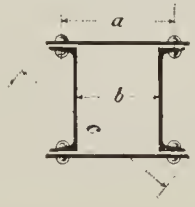
SAFE LOADS IN POUNDS FOR PLATE AND CHANNEL COLUMNS

SQUARE ENDS

Based on Gordon's Formula: $$p = \frac{50000}{1 + \frac{(12L)^2}{36000r^2}}$$ Factor of safety, 4.

PLATES	WIDTH OF PLATE 8″			WIDTH OF PLATE 9″			WIDTH OF PLATE 10″		
	6″ 8 Pounds			**7″ 9¾** Pounds			**8″ 11¼** Pounds		
	¼″ Plate	5/16″ Pl.	3/8″ Plate	¼″ Plate	5/16″ Pl.	3/8″ Plate	¼″ Plate	5/16″ Plate	3/8″ Plate
Area	8.76	9.76	10.76	10.20	11.32	12.45	11.70	12.95	14.20
Weight	29.60	33.00	36.40	34.80	38.60	42.50	39.50	43.70	48.00
Least Radius of Gyration	2.35	2.35	2.34	2.63	2.63	2.62	2.98	2.97	2.97
Length									
8	105000	117000	129000	123000	137000	150000	142000	157000	172000
9	103000	115000	127000	122000	135000	148000	141000	156000	171000
10	102000	114000	125000	121000	134000	147000	140000	155000	170000
11	101000	112000	124000	120000	132000	145000	139000	153000	168000
12	99000	111000	122000	118000	130000	143000	137000	152000	167000
13	98000	109000	120000	116000	129000	141000	136000	150000	165000
14	96000	107000	118000	115000	127000	140000	134000	149000	163000
15	94000	105000	115000	113000	125000	138000	133000	147000	161000
16	92000	103000	114000	109000	123000	135000	131000	145000	159000
17	91000	101000	111000	109500	121000	133000	129000	142000	156000
18	89000	99000	109000	108000	119000	131000	128000	141000	154000
19	87000	97000	107000	106000	118000	128000	125000	139000	152000
20	85000	95000	104000	104000	115000	126000	124000	137000	150000
21	83000	92000	101000	102000	113000	124000	122000	135000	148000
22	81000	90000	99000	99000	110000	121000	120000	133000	146000
23	79000	88000	97000	98000	109000	120000	118000	130000	143000
24	77000	86000	94000	96000	106000	116000	116000	128000	141000
25	.....	.....	.....	94000	104000	114000	113000	126000	138000
26	.....	.....	.....	92000	102000	112000	112000	124000	136000
28	.....	.....	.....	.....	.....	.....	108000	120000	131000
30	.....	.....	.....	.....	.....	.....	104000	115000	126000

Size Channel	*b* ins.	*a* ins.	*c* ins.
6″ 8 lbs.	3 1/8	5 3/4	10 5/16
7″ 9¾ “	4 1/8	6 1/2	11 3/4
8″ 11¼ “	4 3/4	7 1/4	13 1/8
9″ 13¼ “	5 1/2	8 1/4	14 1/2
10″ 15 “	6	9	15 5/16
10″ 30 “	5 1/8	9	15 5/16



Size Channel	*b* ins.	*a* ins.	*c* ins.
12″ 20½ lbs.	7 3/4	11 1/4	18 3/4
12″ 30 “	7 1/4	11 1/4	18 3/4
12″ 40 “	6 3/4	11 1/4	18 3/4
15″ 33 “	9 3/4	13 1/2	23 3/16
15″ 40 “	9 1/2	13 1/2	23 3/16
15″ 50 “	9 1/8	13 1/2	23 3/16

SAFE LOAD IN POUNDS FOR PLATE AND CHANNEL COLUMNS

SQUARE ENDS

Based on Gordon's Formula: $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$ Factor of safety, 4.

PLATES	WIDTH OF PLATE 11″			WIDTH OF PLATE 12″			WIDTH OF PLATE 12″		
	9″ 13¼ Pounds			**10″ 15** Pounds			**10″ 30** Pounds		
	5/16″ Pl.	3/8″ Plate	7/16″ Pl.	5/16″ Pl.	3/8″ Plate	1/2″ Plate	7/16″ Plate	1/2″ Plate	5/8″ Plate
Area of Column Section	14.66	16.03	17.40	16.42	17.92	20.92	28.14	29.64	32.64
Weight of Column	49.90	54.60	59.20	55.50	60.60	70.80	95.70	100.80	111.00
Least Radius of Gyration	3.32	3.31	3.30	3.61	3.59	3.58	3.36	3.36	3.37
Length									
8	179000	196000	213000	201000	220000	257000	344000	362000	399000
9	178000	194000	212000	200000	218000	255000	341000	359000	396000
10	177000	193000	210000	199000	217000	254000	340000	358000	394000
11	176000	192000	208000	198000	216000	252000	338000	356000	389000
12	174000	191000	207000	197000	215000	250000	334000	352000	388000
13	172000	188000	205000	195000	213000	249000	333000	350000	385000
14	171000	187000	203000	193000	211000	247000	329000	346000	381000
15	169000	185000	201000	192000	209000	244000	326000	344000	379000
16	168000	183000	199000	191000	207000	242000	322000	339000	375000
17	165000	181000	196000	189000	205000	239000	320000	336000	371000
18	164000	179000	194000	187000	204000	238000	315000	332000	367000
19	162000	178000	192000	185000	202000	236000	312000	329000	363000
20	160000	175000	189000	183000	199000	232000	307000	324000	358000
21	158000	172000	187000	181000	198000	230000	305000	321000	354000
22	156000	171000	184000	179000	195000	228000	301000	317000	349000
23	153000	167000	182000	176000	192000	225000	297000	313000	344000
24	152000	165000	179000	175000	190000	222000	293000	308000	339000
25	149000	163000	177000	172000	187000	219000	289000	304000	335000
26	147000	160000	174000	170000	186000	216000	284000	299000	330000
28	143000	155000	169000	165000	180000	210000	276000	290000	320000
30	138000	150000	163000	161000	175000	204000	267000	281000	310000
32	134000	146000	158000	156000	170000	199000	258000	272000	300000
34	129000	141000	153000	152000	165000	192000	250000	263000	290000
36	.....	.....	.....	147000	160000	186000	241000	254000	280000

SAFE LOADS IN POUNDS FOR PLATE AND CHANNEL COLUMNS

SQUARE ENDS

Based on Gordon's Formula: $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$ Factor of Safety, 4.

PLATES	WIDTH OF PLATE, 14″			WIDTH OF PLATE, 14″			WIDTH OF PLATE, 14″		
	12″ 20½ Pounds			**12″ 30** Pounds			**12″ 40** Pounds		
	5/16″ Pl.	3/8″ Plate	1/2″ Plate	7/16″ Pl.	1/2″ Plate	5/8″ Plate	7/16″ Plate	1/2″ Plate	5/8″ Plate
Area of Column Section	20.81	22.56	26.06	29.89	31.64	35.14	35.77	37.52	41.02
Weight of Column	70.8	76.70	88.60	101.70	107.60	119.50	121.70	127.60	139.50
Least Radius of Gyration	4.38	4.36	4.32	4.23	4.22	4.21	4.12	4.11	4.11
Length									
10	255000	276000	319000	365000	387000	429000	437000	458000	501000
11	254000	274000	317000	363000	385000	427000	435000	456000	498000
12	253000	273000	316000	362000	383000	425000	433000	454000	496000
13	251000	272000	314000	361000	381000	424000	431000	452000	494000
14	250000	271000	313000	358000	379000	421000	427000	448000	490000
15	249000	270000	311000	355000	376000	418000	423000	444000	485000
16	247000	267000	309000	353000	374000	415000	421000	442000	483000
17	246000	266000	306000	349000	372000	413000	418000	438000	480000
18	244000	264000	304000	348000	368000	409000	415000	435000	476000
19	241000	262000	302000	346000	367000	407000	412000	432000	472000
20	240000	260000	300000	343000	363000	402000	408000	428000	468000
21	238000	258000	298000	340000	360000	399000	406000	426000	466000
22	236000	256000	295000	337000	357000	396000	402000	420000	459000
23	235000	254000	292000	334000	354000	393000	397000	414000	455000
24	232000	252000	289000	331000	350000	389000	394000	413000	452000
25	229000	249000	287000	327000	346000	384000	390000	409000	448000
26	228000	246000	285000	325000	343000	381000	386000	405000	442000
28	223000	242000	279000	318000	337000	372000	377000	396000	433000
30	220000	237000	274000	311000	329000	365000	369000	387000	423000
32	214000	232000	267000	304000	321000	357000	360000	377000	412000
34	209000	227000	261000	297000	313000	348000	351000	368000	402000
36	205000	221000	255000	290000	307000	339000	343000	358000	391000
38	200000	216000	249000	282000	299000	332000	334000	350000	383000

SAFE LOADS IN POUNDS FOR PLATE AND CHANNEL COLUMNS

SQUARE ENDS

Based on Gordon's Formula: $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$ Factor of safety, 4.

PLATES	WIDTH OF PLATE 17″			WIDTH OF PLATE 17″			WIDTH OF PLATE 17″		
	15″ 33 Pounds			**15″ 40** Pounds			**15″ 50** Pounds		
	3/8″ Plate	1/2″ Plate	5/8″ Plate	1/2″ Plate	5/8″ Plate	3/4″ Plate	1/2″ Plate	5/8″ Plate	3/4″ Plate
Area of Column Section	32.55	36.80	41.05	40.52	44.77	49.02	46.42	50.67	54.92
Weight of Column	109.40	123.80	138.20	137.80	152.20	166.70	157.80	172.20	186.70
Least Radius of Gyration	5.41	5.36	5.31	5.31	5.27	5.24	5.23	5.20	5.18
Length									
12	399000	451000	502000	496000	548000	600000	568000	620000	672000
13	397000	449000	501000	494000	546000	597000	566000	617000	669000
14	396000	448000	500000	493000	544000	595000	564000	615000	667000
15	394000	446000	497000	491000	542000	592000	561000	612000	664000
16	393000	444000	495000	489000	540000	590000	559000	610000	661000
17	391000	442000	492000	486000	537000	588000	557000	607000	657000
18	390000	440000	490000	484000	535000	586000	555000	604000	654000
19	388000	438000	487000	481000	532000	582000	552000	601000	650000
20	386000	436000	485000	479000	529000	579000	549000	599000	647000
21	384000	433000	483000	477000	526000	575000	545000	595000	644000
22	381000	431000	481000	475000	523000	572000	542000	592000	641000
23	380000	428000	478000	471000	519000	568000	537000	588000	637000
24	378000	426000	475000	469000	516000	565000	535000	584000	633000
25	375000	423000	471000	465000	513000	561000	531000	580000	628000
26	373000	420000	468000	462000	511000	557000	528000	576000	624000
27	370000	417000	464000	458000	507000	554000	524000	571000	619000
28	367000	415000	461000	455000	503000	551000	520000	567000	615000
29	365000	412000	458000	452000	499000	546000	516000	562000	610000
30	363000	409000	453000	450000	495000	542000	513000	558000	605000
32	357000	402000	449000	443000	487000	533000	505000	549000	595000
34	351000	397000	441000	435000	479000	524000	496000	542000	585000
36	345000	390000	433000	427000	472000	515000	487000	532000	574000
38	340000	383000	425000	420000	464000	505000	478000	522000	566000
40	334000	376000	419000	413000	455000	498000	471000	512000	555000
42	327000	370000	411000	405000	446000	488000	462000	502000	544000

SAFE LOADS IN POUNDS FOR SINGLE I-BEAM COLUMNS

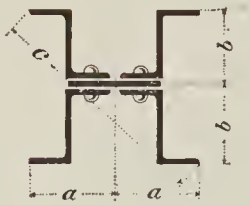
Based on Gordon's Formula: $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$ Factor of safety, 4

Depth of Beam	Weight Per Foot	Area of Section	Least Radius of Gyration	LENGTH IN FEET							
	Pounds	Sq. Inches	Inches	6	8	10	12	14	16	18	20
3	5½	1.63	.53	13000	11000	.....	.....	.....	.....	.....	.....
4	7½	2.21	.59	20000	16000	13000	.....	.....	.....	.....	.....
5	9¾	2.87	.65	27000	22000	18000	.....	.....	.....	.....	.....
6	12¼	3.61	.72	35000	30000	25000	21000	.....	.....	.....	.....
7	15	4.42	.78	45000	39000	33000	28000	.....	.....	.....	.....
8	18	5.33	.84	55000	49000	43000	37000	31000	.....	.....	.....
9	21	6.31	.90	67000	60000	53000	46000	40000	.....	.....	.....
9	25	7.35	.88	78000	69000	60000	53000	46000	.....	.....	.....
10	25	7.37	.97	80000	73000	65000	57000	50000	44000	.....	.....
10	30	8.82	.93	94000	85000	75000	66000	58000	50000	.....	.....
12	31½	9.26	1.01	102000	93000	83000	94000	65000	58000	.....	.....
12	40	11.84	1.08	132000	121000	110000	99000	88000	79000	70000	.....
12	50	14.71	1.05	163000	149000	135000	121000	108000	96000	85000	.....
15	42	12.48	1.08	139000	128000	116000	105000	93000	83000	74000	.....
15	50	14.71	1.04	162000	149000	134000	120000	106000	94000	84000	.....
15	60	17.67	1.21	201000	188000	173000	159000	144000	30000	117000	.....
18	55	15.93	1.15	180000	166000	153000	139000	125000	12000	100000	.....
18	70	20.59	1.09	230000	212000	192000	173000	155000	38000	123000	.....
20	65	19.08	1.21	217000	203000	187000	171000	155000	141000	126000	57000
20	80	23.73	1.39	276000	261000	246000	229000	211000	194000	177000	81000
24	80	23.32	1.36	271000	256000	239000	223000	205000	187000	172000	78000

Loads given to the right of zigzag line are for lengths greater than 125 radii of gyration, and should not be used unless beams are stiffened or braced sideways.

SAFE LOADS IN POUNDS FOR Z-BAR COLUMNS

SQUARE ENDS



Based on Gordon's Formula: $p = \dfrac{50000}{1 + \dfrac{(12L)^2}{36000r^2}}$

Factor of safety, 4.

SECTION OF COLUMN	Thickness of Web-Plate and Z-Bars	Area of Column Section	Weight of Column per Foot	Least Radius of Gyration	A	B	C	LENGTH IN FEET					
	In.	Sq. In.	Lbs.	In.	In.	In.	In.	4	6	8	10	12	14
4-3″ Z-Bars and 1 Web-Plate 5¾″ Wide	1/4	9.31	31.7	1.86	5 7/16	3 1/8	12 9/16	114000	112000	108000	104000	100000	95000
	5/16	11.72	39.7	1.91	5 7/16	3 7/32	12 5/8	144000	141000	137000	132000	126000	121000
	3/8	13.59	46.1	1.88	5 5/16	3 1/16	12 3/8	167000	163000	158000	153000	146000	139000
	7/16	15.97	54.2	1.93	5 5/16	3 9/32	12 1/2	196000	192000	187000	180000	173000	165000
	1/2	17.62	59.8	1.90	5 5/16	3 1/4	12 1/4	216000	212000	206000	198000	190000	181000
	9/16	19.97	67.8	1.95	5 3/16	3 1/32	12 5/16	245000	240000	234000	226000	216000	207000
4-4″ Z-Bars and 1 Web-Plate 6¾″ Wide	1/4	11.31	38.5	2.46	6 5/16	4 1/8	15 1/16	140000	138000	135000	132000	129000	125000
	5/16	14.22	48.4	2.51	6 5/16	4 7/32	15 3/16	176000	174000	171000	167000	163000	158000
	3/8	17.16	58.2	2.56	6 5/16	4 5/16	15 5/16	212000	210000	207000	202000	197000	191000
	7/16	19.14	65.2	2.49	6 1/8	4 7/32	14 7/8	237000	234000	230000	225000	219000	213000
	1/2	22.00	74.7	2.54	6 1/8	4 5/16	15	272000	269000	265000	259000	253000	245000
	9/16	24.89	84.5	2.59	6 1/8	4 13/32	15 1/8	308000	305000	300000	293000	287000	279000
	5/8	26.41	89.9	2.52	5 15/16	4 5/16	14 11/16	327000	323000	317000	310000	302000	293000
	11/16	29.22	99.4	2.57	5 15/16	4 13/32	14 13/16	362000	358000	352000	344000	336000	327000
	3/4	32.06	109.2	2.62	5 15/16	4 1/2	14 7/8	397000	392000	386000	379000	369000	360000
4-5″ Z-Bars and 1 Web-Plate 7″ Wide	5/16	15.78	52.8	3.08	6 9/16	5 5/32	16 11/16	.....	194000	192000	189000	186000	182000
	3/8	19.03	64.5	3.13	6 9/16	5 1/4	16 13/16	.....	234000	232000	229000	225000	220000
	7/16	22.31	76.0	3.18	6 9/16	5 11/32	16 15/16	.....	275000	272000	269000	264000	259000
	1/2	24.50	83.5	3.10	6 3/8	5 1/4	16 1/2	.....	302000	298000	294000	289000	283000
	9/16	27.70	94.2	3.15	6 3/8	5 11/32	16 5/8	.....	341000	338000	333000	327000	321000
	5/8	30.94	105.3	3.21	6 3/8	5 7/16	16 3/4	.....	381000	377000	372000	367000	359000
	11/16	32.66	111.2	3.13	6 5/16	5 11/32	16 5/16	.....	402000	398000	392000	386000	378000
	3/4	35.81	121.9	3.18	6 3/16	5 7/16	16 1/2	.....	441000	437000	431000	423000	415000
	13/16	39.00	132.5	3.24	6 3/16	5 17/32	16 5/8	.....	481000	476000	469000	462000	454000
4-6″ Z-Bars and 1 Web-Plate 7¾″ Wide	3/8	21.28	72.3	3.68	7 1/8	6 3/16	18 7/8	.....	263000	261000	258000	255000	251000
	7/16	24.94	84.7	3.73	7 1/8	6 9/32	19	.....	309000	306000	303000	299000	295000
	1/2	28.62	97.2	3.78	7 1/8	6 5/16	19 1/8	.....	354000	352000	348000	344000	339000
	9/16	31.08	105.6	3.70	6 15/16	6 9/32	18 3/4	.....	385000	381000	377000	373000	367000
	5/8	34.69	118.1	3.75	6 15/16	6 5/16	18 13/16	.....	429000	426000	421000	417000	411000
	11/16	38.33	130.5	3.73	6 15/16	6 15/32	19	.....	474000	471000	466000	460000	453000
	3/4	40.31	137.0	3.67	6 3/4	6 5/16	18 9/16	.....	499000	494000	490000	483000	476000
	13/16	43.87	149.0	3.65	6 3/4	6 15/32	18 11/16	.....	543000	538000	533000	525000	519000
	7/8	47.47	161.5	3.63	6 3/4	6 9/16	18 7/8	.....	587000	582000	575000	569000	559000

SAFE LOADS IN POUNDS FOR Z-BAR COLUMNS

SQUARE ENDS

Based on Gordon's Formula: $$p = \frac{50000}{1 + \frac{(12L)^2}{36000r^2}}$$

Factor of safety, 4.

LENGTH IN FEET

16	18	20	22	24	26	28	30	32	34	36	Thickness of Web-Plate and Z-Bars Inches
90000	85000	79000	.....	.....	.....	.....	.....	.....	.....	.....	1/4
114000	108000	102000	.....	.....	.....	.....	.....	.....	.....	.....	5/16
132000	124000	117000	.....	.....	.....	.....	.....	.....	.....	.....	3/8
157000	148000	139000	.....	.....	.....	.....	.....	.....	.....	.....	7/16
172000	162000	153000	.....	.....	.....	.....	.....	.....	.....	.....	1/2
197000	186000	175000	.....	.....	.....	.....	.....	.....	.....	.....	9/16
121000	117000	112000	107000	102000	98000	.....	.....	.....	.....	.....	1/4
153000	147000	142000	136000	130000	124000	.....	.....	.....	.....	.....	5/16
186000	179000	173000	166000	158000	151000	.....	.....	.....	.....	.....	3/8
206000	198000	190000	183000	175000	167000	.....	.....	.....	.....	.....	7/16
237000	229000	220000	211000	203000	194000	.....	.....	.....	.....	.....	1/2
270000	260000	251000	241000	231000	222000	.....	.....	.....	.....	.....	9/16
285000	275000	264000	253000	243000	232000	.....	.....	.....	.....	.....	5/8
317000	305000	294000	282000	271000	259000	.....	.....	.....	.....	.....	11/16
349000	337000	326000	313000	299000	288000	.....	.....	.....	.....	.....	3/4
178000	174000	169000	164000	159000	154000	148000	143000	138000	133000	.....	5/16
215000	210000	204000	199000	192000	186000	181000	174000	168000	161000	.....	3/8
254000	247000	241000	234000	228000	220000	213000	206000	198000	191000	.....	7/16
276000	270000	262000	255000	248000	239000	231000	223000	215000	206000	.....	1/2
314000	306000	299000	289000	281000	271000	263000	254000	245000	236000	.....	9/16
352000	344000	335000	325000	316000	306000	297000	287000	276000	267000	.....	5/8
370000	360000	351000	341000	330000	320000	310000	298000	288000	277000	.....	11/16
407000	396000	386000	376000	365000	353000	342000	331000	318000	307000	.....	3/4
445000	433000	423000	411000	400000	388000	376000	362000	350000	338000	.....	13/16
248000	243000	238000	233000	228000	221000	216000	210000	204000	199000	192000	3/8
290000	285000	279000	274000	268000	261000	254000	248000	241000	234000	227000	7/16
334000	328000	322000	315000	309000	300000	293000	286000	278000	270000	263000	1/2
362000	354000	348000	341000	332000	325000	316000	308000	300000	290000	282000	9/16
404000	397000	390000	381000	373000	364000	354000	345000	336000	326000	317000	5/8
446000	439000	429000	421000	412000	401000	391000	381000	370000	360000	348000	11/16
468000	460000	451000	440000	431000	419000	409000	397000	387000	374000	364000	3/4
509000	500000	489000	479000	467000	456000	443000	432000	419000	407000	394000	13/16
551000	539000	529000	516000	505000	491000	480000	465000	453000	438000	426000	7/8

NOTES ON TRUSSES

A common type of combination truss is illustrated on page 69, the top and bottom chords and compression members being made of wood with iron rods to take the tension.

Wood members at connections are notched in and bolted, or castings may be used. In all cases the connections should be of sufficient strength to develop the entire strength of the members connected.

Where the top chord is notched into the bottom chord care should be taken to leave sufficient section in the bottom chord at that point to resist both shear and bending.

Where the bottom chord forms an arched ceiling provision must be made either in the truss or the supporting walls to take the thrust, which might, by pushing out the supports, cause the structure to fail.

Steel trusses may be built much stronger than wood trusses. They are lighter, more durable, and cheaper in many cases, especially for long spans.

The cost of assembling is saved, as in most cases they can be shipped in one or two pieces.

They may be erected more easily on account of their lightness and stiffness. The illustrations on page 70 show a few of the types we have made.

Our Engineering Department is prepared to furnish designs and estimates on all classes of this work, promptly on receipt of necessary data.

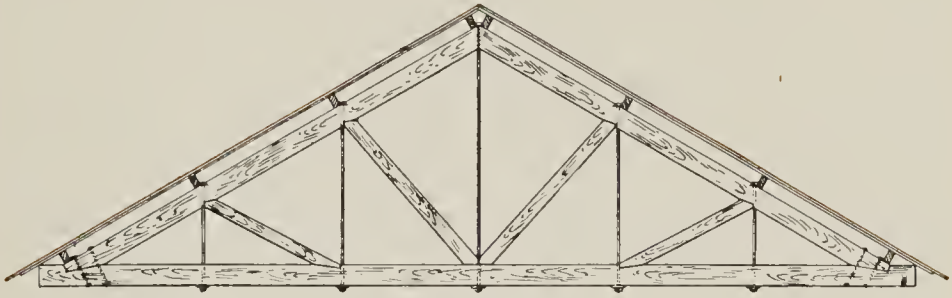
APPROXIMATE LOADS PER HORIZONTAL SQUARE FOOT FOR ROOFS OF SPANS NOT EXCEEDING 75 FEET

Corrugated Iron, unboarded	8 pounds	Shingles, on lath	10 pounds
Corrugated Iron, on boards	11 pounds	Shingles, on $\frac{7}{8}$" boards	13 pounds
Slate, on lath	13 pounds	Tar and Gravel, 4-ply felt on $\frac{7}{8}$" boards	9½ pounds
Slate, on 1¼" boards	16 pounds		

Add for plastered ceiling, 10 pounds.
For spans over 75′ add 4 lbs. per square foot to above loads.
Snow and Wind, unless separately calculated, 30 lbs.

Proportion of Rise to Span	ANGLE		Length Rafter to Rise	Proportion of Rise to Span	ANGLE		Length Rafter to Rise
	Degrees	Minutes			Degrees	Minutes	
$\frac{1}{2}$	45°		1.4142	$\frac{1}{4}$	26°	34′	2.2361
$\frac{1}{3}$	33°	41′	1.8028	$\frac{1}{5}$	21°	48′	2.6926
$2\frac{1}{3}$	30°		2.	$\frac{1}{6}$	18°	26′	3.1623

WOOD TRUSSES



Wooden Roof Truss.

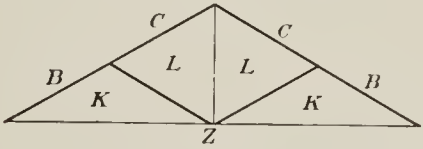


Fig. 1

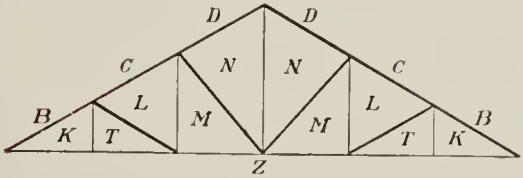


Fig 2

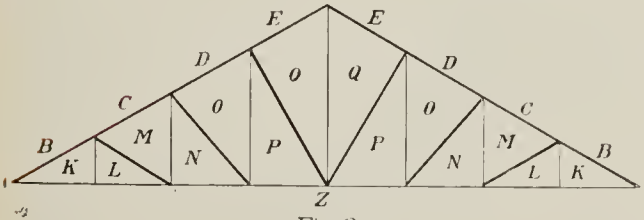


Fig. 3

Light lines denote tension. Heavy lines denote compression.

Stress in any member = coefficient × total load carried.

Total load = Span in feet × distance between trusses in feet × load per square foot.

Trusses loaded unsymmetrically or with load on bottom chord will require special calculations.

Use Fig. 1 for spans up to 30 feet.
" 2 " " 50 "
" 3 " " 70 "

COEFFICIENTS

Member of Truss	Pitch (depth to span)		
	1 : 3	30°	1 : 4
Fig. 1			
BK	.676	.750	.837
CL	.450	.500	.558
KL	.225	.250	.279
KZ	.532	.647	.750
LL	.250	.250	.250
Fig. 2			
BK	.750	.835	.930
CL	.600	.665	.749
DN	.450	.497	.555
KT	.0	.0	.0
LM	.083	.083	.083
NN	.334	.334	.334
TL	.150	.170	.185
MN	.207	.220	.235
KZ	.625	.720	.830
TZ	.625	.720	.830
MZ	.500	.575	.667
Fig. 3			
BK	.785	.870	.986
CM	.673	.750	.845
DO	.560	.620	.700
EQ	.450	.500	.560
QQ	.375	.375	.375
PQ	.210	.215	.225
OP	.125	.125	.125
NO	.156	.165	.176
MN	.062	.062	.062
LM	.112	.124	.141
KL	.0	.0	.0
KZ	.655	.755	.875
LZ	.655	.755	.875
NZ	.560	.645	.750
PZ	.470	.540	.625

TYPICAL STEEL TRUSSES

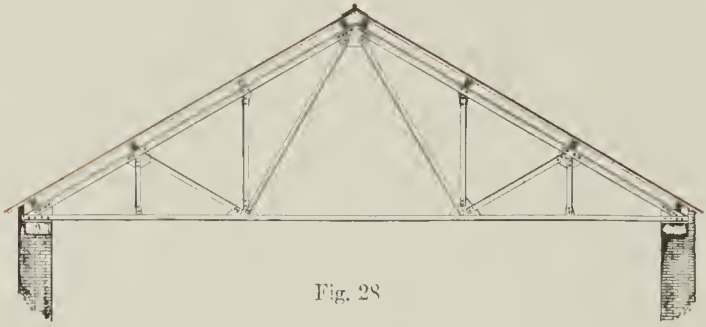


Fig. 28

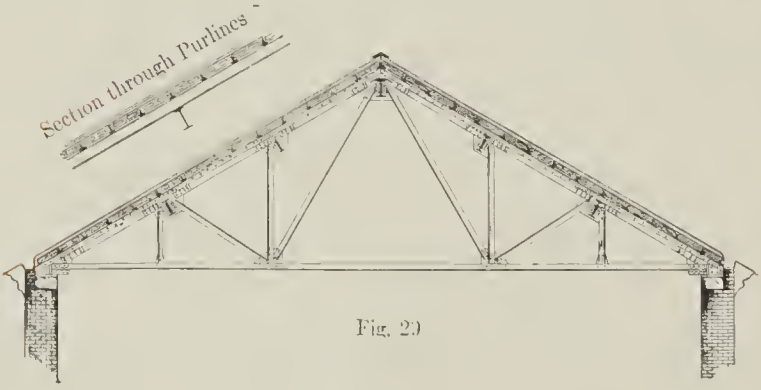


Fig. 29

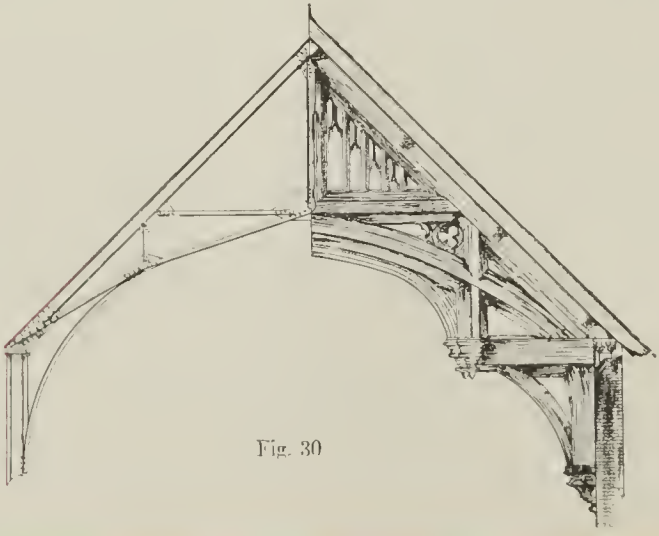


Fig. 30

ROOF TRUSSES

TABLES FOR FINDING STRESSES IN MEMBERS FOR ROOF TRUSSES OF THE DIFFERENT TYPES AND PITCHES AS GIVEN BELOW AND OF ANY SPAN.

RULE: To find the stress in any member, multiply the coefficient given for that member by total load carried by truss (=span in feet × distance between trusses in feet × weight per square foot). If the truss is acted upon by wind forces or other unsymmetrical loading, the stresses in the members must be calculated accordingly and combined with the load stresses as found below.

Member of Truss	Pitch (Depth to Span)			
	1/3	30°	1/4	1/5
Fig. **1**,				
A-a	.675	.750	.838	1.010
B-b	.537	.625	.726	.917
C-a	.563	.650	.750	.938
C-c	.375	.433	.500	.625
a-b	.208	.217	.224	.232
b-c	.188	.217	.250	.313
Fig. **2**,				
A-a	.750	.833	.930	1.120
B-b	.589	.666	.757	.928
C-c	.568	.666	.783	.995
D-a	.625	.721	.833	1.042
D-d	.375	.433	.500	.625
a-b	.155	.167	.180	.202
b-c	.155	.167	.180	.202
c-d	.250	.288	.333	.417
Fig. **3**,				
A-a	.788	.874	.978	1.178
B-b	.718	.812	.922	1.131
C-c	.649	.750	.866	1.085
D-d	.580	.687	.810	1.038
E-a	.655	.758	.875	1.094
E-f	.562	.650	.750	.938
E-e	.375	.433	.500	.625
a-b	.104	.108	.112	.116
b-f	.093	.108	.125	.156
f-g	.208	.216	.224	.232
g-e	.093	.108	.125	.156
c-d	.104	.108	.112	.116
g-e	.187	.217	.250	.313
d-e	.280	.325	.375	.469

NOTE—Heavy lines denote compression and light lines tension members. Loads are considered as concentrated at the joints.

Fig. 1.

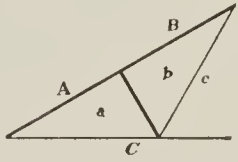


Fig. 2.

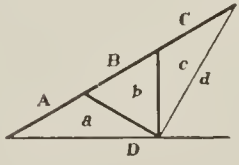
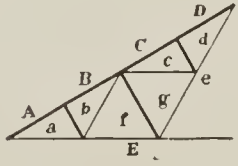


Fig. 3.



VALUES OF SINGLE ANGLES IN COMPRESSION

By Formula, $S = 12{,}500 - 500 \frac{L}{r}$

S = Safe Fibre Stress.

L = Length of Strut in feet.

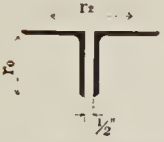
r = Radius of Gyration.

$\frac{L}{r}$ Not to exceed 10 except for lateral bracing, where it may be 12.

Size of Angles	Radius of Gyr.	Gross Area.	LENGTH IN FEET.							
			3	4	5	6	8	10	12	14
2 x2 x 3/16	.40	.72	6,300	5,400	.....	.....	.....	.....	.....	.....
2 x2 x 1/4	.39	.94	8,130	6,910	.....	.....	.....	.....	.....	.....
2 x2 x 5/16	.39	1.15	9,950	8,450	.....	.....	.....	.....	.....	.....
1½x2 x 3/16	.43	.81	7,290	6,360	5,430	.....	.....	.....	.....	.....
1½x2 x 1/4	.42	1.06	9,490	8,210	7,240	.....	.....	.....	.....	.....
1½x2 x 5/16	.42	1.31	11,680	10,150	8,580	.....	.....	.....	.....	.....
1½x2 1½x 1/4	.49	1.19	11,210	9,996	8,810	.....	.....	.....	.....	.....
1½x2 1½x 5/16	.49	1.47	13,890	12,350	10,870	.....	.....	.....	.....	.....
1½x2 1½x 3/8	.48	1.73	16,260	14,360	12,970	.....	.....	.....	.....	.....
3 x2 1½x 1/4	.53	1.31	12,640	11,460	10,220	8,970	.....	.....	.....	.....
3 x2 1½x 5/16	.53	1.62	15,630	14,170	12,640	11,090	.....	.....	.....	.....
3 x2 1½x 3/8	.52	1.92	18,430	16,800	14,590	12,960	.....	.....	.....	.....
3 x3 x 1/4	.59	1.44	14,330	13,100	11,880	10,660	.....	.....	.....	.....
3 x3 x 5/16	.59	1.78	17,710	16,200	14,680	13,170	.....	.....	.....	.....
3 x3 x 3/8	.58	2.11	20,890	19,100	17,300	15,500	.....	.....	.....	.....
3½x3 1½x 5/16	.69	2.09	21,630	20,060	18,600	17,140	14,000	.....	.....	.....
3½x3 1½x 3/8	.69	2.48	25,670	23,810	22,070	20,340	16,620	.....	.....	.....
4 x4 x 5/16	.79	2.40	25,440	24,000	22,600	20,880	17,880	.....	.....	.....
4 x4 x 3/8	.79	2.86	30,330	28,600	27,030	24,880	21,310	.....	.....	.....
4 x4 x 7/16	.78	3.31	35,080	32,930	30,950	28,960	24,330	.....	.....	.....
5 x5 x 3/8	.99	3.61	39,710	37,900	36,100	34,110	30,540	26,890	.....	.....
5 x5 x 7/16	.98	4.18	45,980	43,680	41,590	39,500	35,320	30,930	.....	.....
5 x5 x 1/2	.98	4.75	52,250	49,640	47,260	44,890	40,140	35,150	.....	.....
6 x6 x 3/8	1.19	4.36	49,050	47,300	45,340	43,600	39,890	36,190	32,480	.....
6 x6 x 7/16	1.19	5.06	56,920	54,900	52,620	55,800	46,300	42,000	37,700	.....
6 x6 x 1/2	1.18	5.75	64,690	62,100	59,800	57,270	52,320	48,300	42,800	.....
6 x6 x 9/16	1.18	6.43	72,340	69,440	66,870	64,040	58,510	53,050	47,900	.....
6 x6 x 5/8	1.18	7.11	79,990	76,790	73,940	70,800	64,700	59,000	52,960	.....
6 x6 x 11/16	1.17	7.78	87,290	84,020	80,910	77,410	70,800	64,180	57,570	.....
6 x6 x 3/4	1.17	8.44	94,690	91,150	87,780	83,980	76,800	69,630	62,460	.....
6 x6 x 13/16	1.17	9.09	101,980	98,170	94,540	90,450	82,720	74,990	67,270	.....
6 x6 x 7/8	1.17	9.74	109,090	105,190	101,300	96,910	88,630	80,400	72,080	.....
8 x8 x 1½	1.58	7.75	91,990	87,190	84,860	82,150	77,110	72,460	66,420	62,700
8 x8 x 5/8	1.58	9.61	114,060	108,110	105,220	101,890	95,620	89,950	83,610	77,800
8 x8 x 3/4	1.57	11.44	135,730	128,700	125,260	121,260	113,830	107,900	99,500	92,190
8 x8 x 7/8	1.57	13.23	156,970	148,840	144,800	140,240	131,640	126,800	115,100	106,500

VALUES OF TWO ANGLES IN COMPRESSION

EQUAL LEGGED ANGLES



By Formula: $S = 12500 - 500\,\frac{L}{r}$

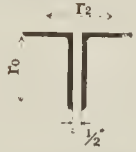
S = Safe Fiber Stress. r = Radius of Gyration in inches.

L = Length in feet. $\frac{L}{r}$ not to exceed 10.

Size of Angles	Radii of Gyration	Area of Two Angles	LENGTH IN FEET							
			4	6	8	10	12	14	16	18
6 x 6 x ¾	r_0=1.83 r_2=2.73	16.88	192600 198600	183300 192500	174100 186300	164900 180100	155700 173900	146500 167800	137300 161600	128100 155400
6 x 6 x ½	r_0=1.86 r_2=2.68	11.50	131400 135100	125200 130800	119000 126500	112800 122200	106600 117900	100400 113700	94300 109300	88000 105000
6 x 6 x ⅜	r_0=1.87 r_2=2.67	8.72	99700 102500	95000 99200	90300 95900	85700 92700	81100 89400	76400 86170	71800 82900	67100 79650
5 x 5 x ½	r_0=1.54 r_2=2.28	9.50	106400 110400	100200 106300	94100 102100	88000 97900	81700 93800	75500 89600	 85500	 81300
5 x 5 x ⅜	r_0=1.56 r_2=2.26	7.22	81000 83900	76400 80600	71800 77500	67100 74300	62400 71000	57800 67900	 64700	 61500
4 x 4 x ½	r_0=1.22 r_2=1.88	7.50	81500 85800	75300 81300	69200 77800	63000 73800	56900 69800	 65800	 61800	 57900
4 x 4 x ⅜	r_0=1.23 r_2=1.86	5.72	62200 65400	57500 62300	52900 59200	48300 56100	43500 53000	 49900	 46900	 43800
4 x 4 x 5/16	r_0=1.24 r_2=1.85	4.80	52300 54800	48400 52200	44500 49600	40700 47000	36900 44400	 41900	 39400	 36900
3½ x 3½ x ⅜	r_0=1.07 r_2=1.67	4.96	52700 56000	48100 53100	43500 50100	38800 47100	 44100	 41200	 38200	....
3½ x 3½ x 5/16	r_0=1.08 r_2=1.65	4.18	44500 47200	40600 44600	36800 42100	32900 39600	 37100	 34500	 32000	....
3 x 3 x ⅜	r_0= .91 r_2=1.45	4.22	43500 47000	38800 44100	34200 41200	 38200	 35400	 32400	....	....
3 x 3 x 5/16	r_0= .92 r_2=1.45	3.56	36800 39600	32900 37100	29000 34700	 32300	 29900	 27500	....	....
3 x 3 x ¼	r_0= .93 r_2=1.43	2.88	29800 32000	26700 30000	23600 27900	 25900	 23900	 21800	....	....
2½ x 2½ x ⅜	r_0= .75 r_2=1.26	3.46	34000 37700	29400 35000	 32300	 29500	 26800	....	....	....
2½ x 2½ x 5/16	r_0= .76 r_2=1.25	2.94	29000 32000	25100 29700	 27300	 25000	 22700	....	....	....
2½ x 2½ x ¼	r_0= .77 r_2=1.24	2.38	23600 25900	20500 24000	 22100	 20200	 18300	....	....	....
2 x 2 x ⅜	r_0= .59 r_2=1.07	2.72	24800 28900	 26100	 23800	 21300	....	....	....	....
2 x 2 x 5/16	r_0= .60 r_2=1.05	2.30	21100 24400	17300 22200	 19900	 17800	....	....	....	....
2 x 2 x ¼	r_0= .61 r_2=1.04	1.88	17300 19900	14300 18100	 16300	 14500	....	....	....	....

VALUES OF TWO ANGLES IN COMPRESSION

LONG LEGS TOGETHER



By Formula: $S = 12500 - 500 \frac{L}{r}$

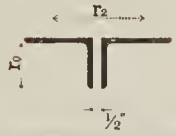
S = Safe Fiber Stress. r = Radius of Gyration in inches.

L = Length in feet. $\frac{L}{r}$ not to exceed 10.

Size of Angles	Radii of Gyration	Area of Two Angles	LENGTH IN FEET							
			4	6	8	10	12	14	16	18
7 x 3½ x 7/16	r_0=2.26 r_2=1.39	8.80	102210 97330	98220 90990	94220 84660	90460 78320	86680 72070	82280 65650	78850 59490	74980 53150
6 x 4 x ½	r_0=1.91 r_2=1.70	9.50	108770 107540	103830 102310	98890 96420	93960 90820	88920 85210	83880 79610	78940 74100	74100 .....
6 x 4 x 3/8	r_0=1.93 r_2=1.67	7.22	82890 81660	79060 77330	75230 72990	71550 68590	67800 64330	64040 59990	60340	56600 .....
5 x 4 x ½	r_0=1.57 r_2=1.77	8.50	95450 96640	90020 91880	84580 87040	79220 82190	73780 77430	68340 72590	 67830	....
5 x 4 x 3/8	r_0=1.59 r_2=1.75	6.46	72610 73390	68540 69630	64340 66020	60400 62270	56400 58590	52330 54910	48260 51230	....
5 x 3½ x ½	r_0=1.58 r_2=1.54	8.00	89870 89600	84800 84500	79740 79300	74690 74030	69600 68800	64560 63600	....	....
5 x 3½ x 5/16	r_0=1.61 r_2=1.50	5.12	57650 57200	54470 53750	51300 50890	48080 46900	44900 43500	41770 40150	38550	....
5 x 3 x ½	r_0=1.59 r_2=1.30	7.50	84300 82200	79500 76400	74650 70800	70150 64800	65450 59150	60750	55950	....
5 x 3 x 5/16	r_0 1.61 r_2=1.26	4.80	54020 52300	51150 48580	48200 44850	45170 40950	42150 37150	39170	36140	....
4 x 3 x ½	r_0=1.25 r_2=1.39	6.50	70900 72540	65650 67280	60480 62500	55230 57850	50150 53230	....	....	....
4 x 3 x 5/16	r_0=1.27 r_2=1.35	4.18	45660 46060	42430 43020	39080 39880	35800 36700	32520 33650	....	....	....
3½ x 3 x ½	r_0=1.08 r_2=1.44	6.00	63900 66660	58320 62520	52740 58320	47280 54180	 50010	 45840	....	....
3½ x 3 x 5/16	r_0=1.10 r_2=1.40	3.86	41220 42730	37750 39990	34220 37210	30720 34450	 31730	 28950	....	....
3½ x 2½ x 3/8	r_0=1.10 r_2=1.15	4.22	45070 45390	41270 41740	37410 38060	33590 34480	....	....	....	....
3½ x 2½ x ¼	r_0=1.12 r_2=1.13	2.88	30860 30900	28390 28370	25720 25830	23150 23280	....	....	....	....
3 x 2½ x 3/8	r_0= .93 r_2=1.22	3.84	39740 41660	35620 38480	31490 35310	 32140	....	....	....	....
3 x 2½ x ¼	r_0= .95 r_2=1.18	2.62	27230 28310	24480 26190	21720 23870	 21650	....	....	....	....
3 x 2 x 3/8	r_0= .94 r_2= .96	3.46	35880 36040	32210 32440	28530 28830	....	....	....	....	....
3 x 2 x ¼	r_0= .95 r_2= .93	2.38	24740 24630	22230 22070	19730 19520	....	....	....	....	....
2½ x 2 x 3/8	r_0= .77 r_2=1.01	3.10	30700 32610	26670 29540	 26460	 23410	....	....	....	....
2½ x 2 x ¼	r_0= .78 r_2= .98	2.12	21080 22180	18350 20010	 17850	....	....	....	....	....

VALUES OF TWO ANGLES IN COMPRESSION

SHORT LEGS TOGETHER



By Formula: $S = 12500 - 500\,\frac{L}{r}$

S = Safe Fiber Stress. r = Radius of Gyration in inches.

L = Length in feet. $\frac{L}{r}$ not to exceed 10.

Size of Angles	Radii of Gyration	Area of Two Angles	LENGTH IN FEET							
			4	6	8	10	12	14	16	18
7 x 3½ x 7/16	r_0= .95 r_2=3.56	8.80	91520 105070	82190 102610	72950 100140	 97680	 95130	 92660	 90200	 87740
6 x 4 x ½	r_0=1.15 r_2=2.94	9.50	102220 112290	93950 109060	85690 105830	77420 102600	 99370	 96140	 92910	 89680
6 x 4 x 3/8	r_0=1.17 r_2=2.92	7.22	77830 85270	71770 82810	65560 80360	59420 77830	 75450	 72920	 70470	 68010
5 x 4 x ½	r_0=1.18 r_2=2.40	8.59	91880 99190	84660 95620	77430 92050	70210 88570	62980 85000	 81430	 77940	 74430
5 x 4 x 3/8	r_0=1.20 r_2=2.38	6.46	70030 75320	64600 72610	59240 69900	53800 67180	48450 64470	 61760	 59040	 56300
5 x 3½ x ½	r_0=1.01 r_2=2.47	8.00	84080 93520	76240 90320	68320 87120	60400 83840	 80640	 77440	 74160	 70770
5 x 3½ x 5/16	r_0=1.03 r_2=2.44	5.12	54070 59800	49100 57550	44130 55600	39120 53500	 51400	 49300	 47210	 45100
5 x 3 x ½	r_0= .83 r_2=2.54	7.50	75670 87820	66600 84900	57600 81970	 78970	 76050	 73050	 70120	 67120
5 x 3 x 5/16	r_0= .85 r_2=2.51	4.80	48720 56210	43060 54290	37440 52370	 50450	 48530	 46610	 44740	 42850
4 x 3 x ½	r_0= .87 r_2=2.02	6.50	66360 74810	58890 71600	51350 68380	 65160	 61940	 58730	 55510	 52290
4 x 3 x 5/16	r_0= .89 r_2=1.97	4.18	42850 48000	38160 45880	33440 43760	 41640	 39520	 37400	 35280	 33160
3½ x 3 x ½	r_0= .88 r_2=1.75	6.00	61320 68160	54480 64680	47700 61320	 57840	 54420	 51000	 47580	.....
3½ x 3 x 5/16	r_0= .90 r_2=1.71	3.83	39680 43730	35360 41490	31070 39220	 36980	 34680	 32460	 30150	.....
3½ x 2½ x 3/8	r_0= .72 r_2=1.79	4.22	41020 48010	35240 45700	 43300	 40930	 38610	 36250	 33900	.....
3½ x 2½ x ¼	r_0= .74 r_2=1.76	2.88	28220 32720	24310 31100	 29460	 27820	 26180	 24540	 22900	.....
3 x 2½ x 3/8	r_0= .74 r_2=1.52	3.84	37630 42930	32410 40440	 37900	 35370	 32830	 30290	.....	.....
3 x 2½ x ¼	r_0= .75 r_2=1.50	2.62	25730 29270	22270 27510	 25780	 24030	 22270	 20510	.....	.....
3 x 2 x 3/8	r_0= .56 r_2=1.59	3.46	30860 38890	 36710	 34450	 32350	 30210	 28040	.....	.....
3 x 2 x ¼	r_0= .58 r_2=1.56	2.38	21540 26700	 25180	 23660	 22110	 20610	 19090	.....	.....
2½ x 2 x 3/8	r_0= .58 r_2=1.32	3.10	28050 34070	 31710	 29360	 27000	 24680	.....	.....	.....
2½ x 2 x ¼	r_0= .59 r_2=1.29	2.12	19310 23210	 21560	 19930	 18300	 16640	.....	.....	.....

SHEARING AND BEARING VALUE OF RIVETS.

Diameter of Rivet Inches	Area in Square Inches	Single Shear at 7500 lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches, at 15,000 lbs. per Square Inch.				
			1/4"	5/16"	3/8"	7/16"	1/2"
3/8	.1104	830	1410	1760	2110		
1/2	.1963	1470	1880	2340	2810	3280	3750
5/8	.3068	2300	2340	2930	3520	4100	4690
3/4	.4418	3310	2810	3520	4220	4920	5630
7/8	.6013	4510	3280	4100	4920	5740	6560
1	.7854	5890	3750	4690	5620	6560	7500

Diameter of Rivet Inches	Area in Square Inches	Single Shear at 9000 lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 lbs. per Square Inch.				
			1/4"	5/16"	3/8"	7/16"	1/2"
3/8	.1104	990	1680	2110	2530		
1/2	.1963	1770	2250	2820	3370	3940	4500
5/8	.3068	2760	2790	3480	4180	4870	5580
3/4	.4418	3970	3370	4210	5050	5910	6750
7/8	.6013	5410	3940	4920	5910	6880	7870
1	.7854	7060	4500	5620	6750	7870	9000

Diameter of Rivet Inches	Area in Square Inches	Single Shear at 10000 lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 lbs. per Square Inch.				
			1/4"	5/16"	3/8"	7/16"	1/2"
3/8	.1104	1100	1880	2340	2810		
1/2	.1963	1960	2500	3130	3750	4380	5000
5/8	.3068	3070	3130	3910	4690	5470	6250
3/4	.4418	4420	3750	4690	5630	6560	7500
7/8	.6013	6010	4380	5470	6570	7660	8750
1	.7854	7850	5000	6250	7500	8750	10000

Diameter of Rivet Inches	Area in Square Inches	Single Shear at 12000 lbs	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 lbs. per Square Inch.				
			1/4"	5/16"	3/8"	7/16"	1/2"
3/8	.1104	1320	2060	2580	3090		
1/2	.1963	2360	2750	3440	4130	4820	5500
5/8	.3068	3680	3440	4300	5160	6020	6880
3/4	.4418	5300	4130	5160	6190	7220	8250
7/8	.6013	7220	4810	6020	7220	8430	9630
1	.7854	9430	5500	6880	8250	9630	11000

Bearing values given above or to the right of the upper zigzag lines are greater than double shear. Bearing values given between the upper and lower zigzag lines are less than double shear and greater than single shear.

SHEARING AND BEARING VALUE OF RIVETS.

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 15,000 lbs. per Square Inch.

9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	Diameter of Rivet Inches
.....	.....	.....	.....	.....	.....	.....	.....	3/8
.....	.....	.....	.....	.....	.....	.....	.....	1/2
5280	5860	.....	.....	.....	.....	.....	.....	5/8
6330	7030	7720	8440	.....	.....	.....	.....	3/4
7380	8200	9030	9850	10670	11480	12300	.....	7/8
8440	9380	10310	11250	12190	13130	14060	15000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 lbs. per Square Inch.

9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	Diameter of Rivet Inches
.....	.....	.....	.....	.....	.....	.....	.....	3/8
.....	.....	.....	.....	.....	.....	.....	.....	1/2
6330	7030	.....	.....	.....	.....	.....	.....	5/8
7590	8440	9280	10130	.....	.....	.....	.....	3/4
8860	9840	10830	11810	12800	13780	14770	.....	7/8
10120	11250	12370	13500	14630	15750	16880	18000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 lbs. per Square Inch.

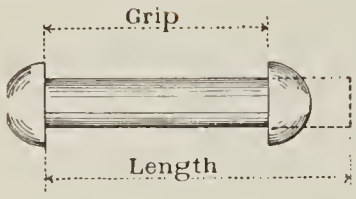
9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	Diameter of Rivet Inches
.....	.....	.....	.....	.....	.....	.....	.....	3/8
.....	.....	.....	.....	.....	.....	.....	.....	1/2
7030	7810	.....	.....	.....	.....	.....	.....	5/8
8440	9380	10310	11250	.....	.....	.....	.....	3/4
9840	10940	12030	13130	14220	15310	16410	.....	7/8
11250	12500	13750	15000	16250	17500	18750	20000	1

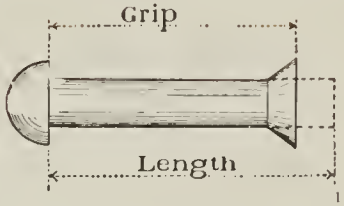
Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 lbs. per Square Inch.

9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	Diameter of Rivet Inches
.....	.....	.....	.....	.....	.....	.....	.....	3/8
.....	.....	.....	.....	.....	.....	.....	.....	1/2
7740	8600	.....	.....	.....	.....	.....	.....	5/8
9280	10320	11340	12380	.....	.....	.....	.....	3/4
10840	12040	13240	14440	15640	16840	18050	.....	7/8
12380	13750	15130	16500	17880	19250	20630	22000	1

Bearing values given below or to the left of the lower zigzag lines, are less than single shear.

LENGTHS OF RIVETS FOR VARIANT GRIPS





Grip in Inches	DIAMETER IN INCHES					DIAMETER IN INCHES					Grip in Inches
	½	⅝	¾	⅞	1	½	⅝	¾	⅞	1	
	Length in Inches					Length in Inches					
½	1 1/2	1 3/4	1 7/8	2	2 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	½
⅝	1 5/8	1 7/8	2	2 1/8	2 1/4	1 1/4	1 3/8	1 3/8	1 1/2	1 1/2	⅝
¾	1 3/4	2	2 1/8	2 1/4	2 3/8	1 3/8	1 1/2	1 5/8	1 5/8	1 5/8	¾
⅞	1 7/8	2 1/8	2 1/4	2 3/8	2 1/2	1 1/2	1 5/8	1 5/8	1 3/4	1 3/4	⅞
1	2	2 1/4	2 3/8	2 1/2	2 5/8	1 5/8	1 3/4	1 3/4	1 7/8	1 7/8	**1**
1 1/8	2 1/8	2 3/8	2 1/2	2 5/8	2 3/4	1 3/4	1 7/8	1 7/8	2	2	**1 1/8**
1 1/4	2 1/4	2 1/2	2 5/8	2 3/4	2 7/8	1 7/8	2	2	2 1/8	2 1/8	**1 1/4**
1 3/8	2 3/8	2 5/8	2 3/4	2 7/8	3	2	2 1/8	2 1/8	2 1/4	2 1/4	**1 3/8**
1 1/2	2 5/8	2 7/8	3	3 1/8	3 1/4	2 1/8	2 1/4	2 3/8	2 3/8	2 1/2	**1 1/2**
1 5/8	2 3/4	3	3 1/8	3 1/4	3 3/8	2 1/4	2 3/8	2 1/2	2 1/2	2 5/8	**1 5/8**
1 3/4	2 7/8	3 1/8	3 1/4	3 3/8	3 1/2	2 3/8	2 1/2	2 5/8	2 5/8	2 3/4	**1 3/4**
1 7/8	3	3 1/4	3 3/8	3 1/2	3 5/8	2 1/2	2 5/8	2 3/4	2 3/4	2 7/8	**1 7/8**
2	3 1/8	3 3/8	3 1/2	3 5/8	3 3/4	2 5/8	2 3/4	2 7/8	2 7/8	3	**2**
2 1/8	3 1/4	3 1/2	3 5/8	3 3/4	3 7/8	2 3/4	2 7/8	3	3	3 1/8	**2 1/8**
2 1/4	3 3/8	3 5/8	3 3/4	3 7/8	4	2 7/8	3	3 1/8	3 1/8	3 1/4	**2 1/4**
2 3/8	3 1/2	3 3/4	3 7/8	4	4 1/8	3	3 1/8	3 1/4	3 1/4	3 3/8	**2 3/8**
2 1/2	3 5/8	3 7/8	4	4 1/8	4 1/4	3 1/8	3 1/4	3 3/8	3 3/8	3 1/2	**2 1/2**
2 5/8	3 3/4	4	4 1/8	4 1/4	4 3/8	3 1/4	3 3/8	3 1/2	3 1/2	3 5/8	**2 5/8**
2 3/4	3 7/8	4 1/8	4 1/4	4 3/8	4 1/2	3 3/8	3 1/2	3 5/8	3 5/8	3 3/4	**2 3/4**
2 7/8	4	4 1/4	4 3/8	4 1/2	4 5/8	3 1/2	3 5/8	3 3/4	3 3/4	3 7/8	**2 7/8**
3	4 1/4	4 1/2	4 5/8	4 3/4	4 7/8	3 3/4	3 7/8	3 7/8	4	4 1/8	**3**
3 1/8	4 3/8	4 5/8	4 3/4	4 7/8	5	3 7/8	4	4	4 1/8	4 1/4	**3 1/8**
3 1/4	4 1/2	4 3/4	4 7/8	5	5 1/8	4	4 1/8	4 1/8	4 1/4	4 3/8	**3 1/4**
3 3/8	4 5/8	4 7/8	5	5 1/8	5 1/4	4 1/8	4 1/4	4 1/4	4 3/8	4 1/2	**3 3/8**
3 1/2	4 3/4	5	5 1/8	5 1/4	5 3/8	4 1/4	4 3/8	4 3/8	4 1/2	4 5/8	**3 1/2**
3 5/8	4 7/8	5 1/8	5 1/4	5 3/8	5 1/2	4 3/8	4 1/2	4 1/2	4 5/8	4 3/4	**3 5/8**
3 3/4	5	5 1/4	5 3/8	5 1/2	5 5/8	4 1/2	4 5/8	4 5/8	4 3/4	4 7/8	**3 3/4**
3 7/8	5 1/8	5 3/8	5 1/2	5 5/8	5 3/4	4 5/8	4 3/4	4 3/4	4 7/8	5	**3 7/8**
4	5 1/4	5 1/2	5 5/8	5 3/4	5 7/8	4 3/4	4 7/8	4 7/8	5	5 1/8	**4**
4 1/8	5 3/8	5 5/8	5 3/4	5 7/8	6	4 7/8	5	5	5 1/8	5 1/4	**4 1/8**
4 1/4	5 1/2	5 3/4	5 7/8	6	6 1/8	5	5 1/8	5 1/8	5 1/4	5 3/8	**4 1/4**
4 3/8	5 5/8	5 7/8	6	6 1/8	6 1/4	5 1/8	5 1/4	5 1/4	5 3/8	5 1/2	**4 3/8**
4 1/2	5 3/4	6	6 1/4	6 3/8	6 1/2	5 1/4	5 3/8	5 3/8	5 1/2	5 5/8	**4 1/2**
4 5/8	6	6 1/4	6 3/8	6 1/2	6 5/8	5 3/8	5 1/2	5 1/2	5 5/8	5 3/4	**4 5/8**
4 3/4	6 1/8	6 3/8	6 1/2	6 5/8	6 3/4	5 1/2	5 5/8	5 5/8	5 3/4	5 7/8	**4 3/4**
4 7/8	6 1/4	6 1/2	6 5/8	6 3/4	6 7/8	5 5/8	5 3/4	5 3/4	5 7/8	6	**4 7/8**
5	6 3/8	6 5/8	6 3/4	6 7/8	7	5 3/4	5 7/8	6	6	6 1/8	**5**

TENSILE STRENGTH OF ■ & ● RODS

AT 10000 LBS. PER SQUARE INCH

SQUARE				ROUND			
Side of Square	Weight per Lin. Foot	Tensile Strength Upset	Tensile Strength not Upset	Diameter	Weight per Lin. Foot	Tensile Strength Upset	Tensile Strength not Upset
Inches	Pounds	Pounds	Pounds	Inches	Pounds	Pounds	Pounds
1/4	.212	.....	270	1/4	.167	.....	270
3/8	.478	.....	680	3/8	.375	.....	680
1/2	.850	2500	1260	1/2	.667	1963	1260
5/8	1.328	3906	2020	5/8	1.043	3068	2020
3/4	1.913	5625	3020	3/4	1.502	4418	3020
7/8	2.603	7656	4200	7/8	2.044	6013	4200
1	3.400	10000	5500	**1**	2.670	7854	5500
1/8	4.303	12656	6940	1/8	3.379	9940	6940
1/4	5.312	15625	8930	1/4	4.173	12272	8930
3/8	6.428	18906	10570	3/8	5.049	14849	10570
1/2	7.650	22500	12950	1/2	6.008	17671	12950
5/8	8.978	26406	15150	5/8	7.051	20739	15150
3/4	10.41	30625	17440	3/4	8.178	24053	17440
7/8	11.95	35156	20480	7/8	9.388	27612	20480
2	13.60	40000	23020	**2**	10.68	31416	23020
1/8	15.35	45156	26500	1/8	12.06	35466	26500
1/4	17.22	50625	30230	1/4	13.52	39761	30230
3/8	19.18	56406	34190	3/8	15.07	44301	34190
1/2	21.25	62500	37150	1/2	16.69	49087	37150
5/8	23.43	68906	41550	5/8	18.40	54110	41550
3/4	25.71	75625	46190	3/4	20.20	59390	46190
7/8	28.10	82650	51080	7/8	22.07	64920	51080
3	30.60	90000	54280	**3**	24.03	70680	54280
1/8	33.20	97650	59570	1/8	26.08	76690	59570
1/4	35.92	105630	65100	1/4	28.20	82960	65100
3/8	38.73	113910	70870	3/8	30.42	89460	70870
1/2	41.65	122500	75480	1/2	32.71	96220	75480
5/8	44.68	131410	81710	5/8	35.09	103210	81710
3/4	47.82	140630	86410	3/4	37.56	110450	86410
7/8	51.05	150160	93050	7/8	40.10	117930	93050

TYPES OF BOLTS

No. 1
Plain Round Drift Bolt

No. 2
Plain Square Drift Bolt

No. 3
Round Drift Bolt, Pointed

No. 4
Square Drift Bolt, Pointed

No. 5
Round Drift Bolt, Head and Point

No. 6
Square Drift Bolt, Head and Point

No. 7
Boat Spike

No. 8
Lag Screw

No. 9
Round Head Machine Bolt

No. 10
Countersunk Head Machine Bolt

No. 11
Expansion Bolt

No. 12
Expansion Bolt

We carry a large stock of Machine Bolts, and can deliver on short notice.
We manufacture bolts as illustrated above in a variety of sizes.
Special bolts of any description made to order.

WEIGHT OF RIVETS AND ROUND HEADED BOLTS WITHOUT NUTS, PER 100

STEEL

Length, Inches	3/8" Diameter	1/2" Diameter	5/8" Diameter	3/4" Diameter	7/8" Diameter	1" Diameter	1 1/8" Diameter	1 1/4" Diameter
1 1/4	5.5	12.8	22.0	29.3	43.9	66.6	93.3	127.
1 1/2	6.3	14.2	24.1	32.4	48.2	72.1	100.	136.
1 3/4	7.0	15.5	26.3	35.5	52.5	77.7	107.	145.
2	7.9	16.9	28.5	38.7	55.7	83.3	114.	153.
2 1/4	8.7	18.3	30.7	41.8	61.0	88.8	121.	162.
2 1/2	9.4	19.7	32.8	44.9	65.2	94.4	128.	171.
2 3/4	10.2	21.1	35.0	48.0	69.5	100.	136.	179.
3	11.0	22.5	37.2	51.1	73.7	105.	143.	188.
3 1/4	11.7	23.9	39.3	54.3	78.0	111.	150.	197.
3 1/2	12.6	25.3	41.5	57.4	82.3	116.	157.	205.
3 3/4	13.4	26.7	43.7	60.5	86.5	122.	164.	214.
4	14.1	28.1	45.9	63.6	90.8	128.	170.	223.
4 1/4	14.9	29.4	48.0	66.7	95.0	134.	177.	231.
4 1/2	15.7	30.8	50.2	69.9	99.3	139.	185.	240.
4 3/4	16.5	32.2	52.4	73.0	104.	145.	192.	249.
5	17.2	33.6	54.5	76.1	108.	150.	199.	258.
5 1/4	18.1	35.0	56.7	79.2	112.	156.	206.	266.
5 1/2	18.8	36.4	58.9	82.3	116.	161.	213.	275.
5 3/4	19.6	37.8	61.1	85.5	120.	166.	220.	284.
6	20.4	39.2	63.2	88.6	124.	172.	227.	292.
6 1/2	21.9	42.0	67.6	95.1	133.	184.	241.	310.
7	23.5	44.7	71.9	101.	142.	195.	255.	327.
7 1/2	25.1	47.5	76.1	108.	150.	206.	269.	345.
8	26.6	50.3	80.6	114.	159.	277.	284.	362.
8 1/2	28.2	53.1	85.0	120.	167.	227.	298.	379.
9	29.8	55.9	89.3	126.	176.	239.	312.	397.
9 1/2	31.3	58.7	93.7	133.	185.	250.	325.	414.
10	32.8	61.4	98.0	139.	193.	261.	340.	431.
10 1/2	34.5	64.2	103.	145.	202.	272.	354.	449.
11	36.0	67.0	107.	151.	210.	284.	368.	466.
11 1/2	37.6	69.8	111.	158.	218.	295.	382.	484.
12	39.2	72.5	115.	164.	227.	306.	396.	501.
Heads	1.8	5.8	11.1	13.6	22.6	39.0	58.0	83.5

TABLE SHOWING THE APPROXIMATE WEIGHT IN POUNDS OF 100 MACHINE BOLTS

L'ngth	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	L'ngth
1 1/2	3.7	6.	9.	19.6	34.3	54.3	.....	.....	.....	.....	1 1/2
2	4.2	7.	10.5	22.2	38.4	60.	90.8	.....	.....	.....	2
2 1/2	4.8	8.	12.	24.8	42.5	65.7	99.1	148.2	209.	277.	2 1/2
3	5.5	9.	13.5	27.5	46.7	71.4	107.4	159.	222.5	293.5	3
3 1/2	6.1	10.	15.	30.1	50.8	77.1	115.7	169.8	236.	310.	3 1/2
4	6.8	11.	16.5	32.8	55.	82.8	124.	180.6	249.5	326.5	4
4 1/2	7.4	12.	18.	35.4	59.1	88.9	132.3	191.4	263.	343.	4 1/2
5	8.1	13.	19.5	38.1	63.3	95.	140.6	202.2	276.5	359.5	5
5 1/2	8.7	14.	21.	40.7	67.4	101.1	148.9	213.	290.	376.	5 1/2
6	9.4	15.	22.5	43.4	71.6	107.2	157.2	223.8	303.5	392.5	6
6 1/2	10.1	16.	24.1	46.	75.7	113.3	165.5	234.6	317.	409.	6 1/2
7	10.8	17.	25.7	48.7	79.9	119.4	173.8	245.4	330.5	425.5	7
7 1/2	11.5	18.	27.3	51.3	84.	125.5	182.1	256.2	344.	442.	7 1/2
8	12.2	19.	28.9	54.	88.2	131.6	190.4	267.	357.5	458.5	8
9	.....	.....	32.1	59.5	96.5	143.8	207.	288.6	385.5	493.	9
10	.....	.....	35.3	65.	104.8	156.	223.6	310.2	413.5	527.5	10
11	.....	.....	38.5	70.5	113.1	168.2	240.2	331.8	441.5	562.	11
12	.....	.....	41.7	76.	121.4	180.4	256.8	353.4	469.5	596.5	12
13	.....	.....	.....	81.5	129.7	192.6	273.4	375.	497.5	631.	13
14	.....	.....	.....	87.	138.	204.8	290.	396.6	525.5	665.5	14
15	.....	.....	.....	92.5	146.3	217.	306.6	418.2	553.5	700.	15
16	.....	.....	.....	98.	154.6	229.2	323.2	439.8	581.5	734.5	16
17	.....	.....	.....	103.5	162.9	241.4	339.8	461.4	609.5	769.0	17
18	.....	.....	.....	109.	171.2	253.6	356.4	483.	637.5	803.5	18
19	.....	.....	.....	114.5	179.5	265.8	373.	504.6	665.5	838.	19
20	.....	.....	.....	120.	187.8	278.	389.6	526.2	693.5	872.5	20
21	.....	.....	.....	.....	.....	290.4	406.5	548.2	721.5	907.	21
22	.....	.....	.....	.....	.....	302.8	423.4	570.2	749.5	941.5	22
23	.....	.....	.....	.....	.....	315.2	440.3	592.2	777.5	976.	23
24	.....	.....	.....	.....	.....	327.6	457.2	614.2	805.5	1010.5	24
25	.....	.....	.....	.....	.....	340.	474.1	636.2	833.5	1045.	25
26	.....	.....	.....	.....	.....	352.4	491.	658.2	861.5	1079.5	26
27	.....	.....	.....	.....	.....	364.8	501.9	680.2	889.5	1114.	27
28	.....	.....	.....	.....	.....	377.2	524.8	702.2	917.5	1148.5	28
29	.....	.....	.....	.....	.....	389.6	541.7	724.2	945.5	1183.	29
30	.....	.....	.....	.....	.....	402.	558.6	746.2	973.5	1217.5	30

Lengths of bolts are given under head over all.

TURNBUCKLES.

ALL DIMENSIONS IN INCHES.

Diameter of Screw U	DIMENSIONS L	T	A	B	C	t	Weight in Pounds.
3/8	7 1/8	9/16	1/2	1 1/16	9/16	3/16	.....
1/2	7 1/2	3/4	5/8	1 3/8	5/8	1/4	.....
5/8	7 7/8	15/16	3/4	1 9/16	13/16	5/16	.....
3/4	8 1/4	1 1/8	7/8	2	1 1/16	11/32	.....
7/8	8 5/8	1 5/16	1	2 1/4	1 1/4	3/8	2 1/2
1	9	1 1/2	1 1/4	2 7/16	1 5/16	7/16	3 1/2
1 1/8	9 3/8	1 11/16	1 1/4	2 9/16	1 7/16	1/2	4
1 1/4	9 3/4	1 7/8	1 1/2	2 3/4	1 9/16	1/2	5 1/4
1 3/8	10 1/8	2 1/16	1 5/8	3 1/16	1 11/16	1/2	6
1 1/2	10 1/2	2 1/4	1 5/8	3 3/16	1 3/4	5/8	7
1 5/8	10 7/8	2 7/16	1 3/4	3 1/2	2	5/8	8 1/2
1 3/4	11 1/4	2 5/8	2	3 3/4	2 1/8	5/8	10
1 7/8	11 5/8	2 13/16	2	3 7/8	2 3/16	11/16	11 1/2
2	12	3	2 1/4	4 1/4	2 3/8	11/16	13
2 1/8	12 3/8	3 3/16	2 1/2	4 1/2	2 1/2	23/32	15
2 1/4	12 3/4	3 3/8	2 1/2	4 3/4	2 11/16	13/16	18
2 3/8	13 1/8	3 9/16	2 3/4	4 7/8	2 3/4	13/16	20
2 1/2	13 1/2	3 3/4	3	5 3/8	3 1/16	27/32	24
2 5/8	13 7/8	3 15/16	3	5 9/16	3 1/8	15/16	28
2 3/4	14 1/4	4 1/8	3 1/4	5 3/4	3 1/4	15/16	30
2 7/8	14 5/8	4 5/16	3 1/4	6 1/16	3 7/16	1 1/32	34
3	15	4 1/2	3 1/2	6 3/8	3 5/8	1 1/32	38

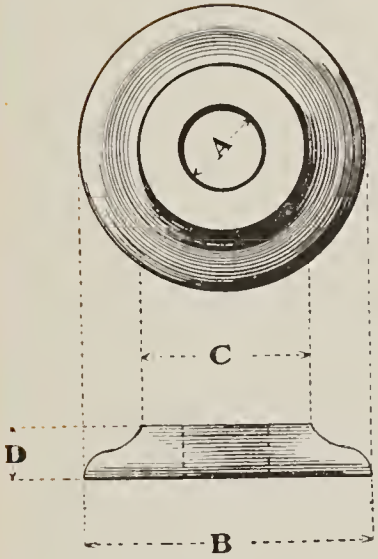
Diameter of Screw U	DIMENSIONS L	T	Weight in Pounds
3/8	7 1/4	7/8	1
1/2	7 1/2	1	1 1/2
5/8	7 7/8	1 1/8	1 3/4
3/4	8 1/4	1 3/8	2 1/4
7/8	8 5/8	1 1/2	3 1/4
1	9	1 11/16	3 1/2
1 1/8	9 3/8	1 7/8	3 3/4
1 1/4	9 3/4	2 1/16	4 1/2
1 3/8	10 1/8	2 1/4	6
1 1/2	10 1/2	2 7/16	7 1/4
1 5/8	10 7/8	2 5/8	8 1/4
1 3/4	11 1/4	2 7/8	9 1/2
1 7/8	11 5/8	3	10
2	12	3 3/16	15
2 1/8	12 3/8	3 3/8	16 1/2
2 1/4	12 5/8	3 9/16	22
2 3/8	12 7/8	3 3/4	27
2 1/2	13 1/2	4	27
2 5/8	13 7/8	4 1/8	29
2 3/4	14 1/4	4 3/8	34
2 7/8	14 5/8	4 5/8	35
3	15	4 3/4	37

Weights given are for turnbuckles only.

BOLTS AND NUTS.

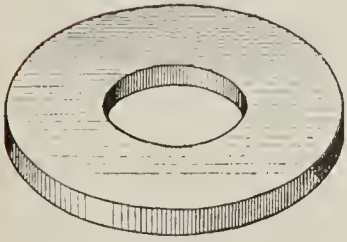
BOLTS U. S. Standard Screw Threads					NUTS Manufactures Standard			
					HEXAGON		SQUARE	
Diam. of Bolt	Number of Threads per Inch	Diam. at Root of Thread	Area of Body of Bolt	Area at Root of Thread	Short Diam.	Long Diam.	Side of Square	Diagonal
Inches		Inches	Sq. In.	Sq. In.	Inches	Inches	Inches	Inches
1/4	20	.185	.049	.027	1/2	.58	1/2	.71
5/16	18	.240	.077	.045	5/8	.72	5/8	.88
3/8	16	.297	.110	.068	3/4	.87	3/4	1.06
7/16	14	.344	.150	.093	7/8	1.01	7/8	1.24
1/2	13	.400	.196	.126	7/8	1.01	7/8	1.24
9/16	12	.454	.249	.162	1 1/8	1.30	1 1/8	1.59
5/8	11	.507	.307	.201	1 1/8	1.30	1 1/8	1.59
3/4	10	.620	.442	.302	1 3/8	1.59	1 3/8	1.94
7/8	9	.731	.601	.419	1 5/8	1.88	1 5/8	2.30
1	8	.837	.785	.550	1 3/4	2.02	1 3/4	2.47
1 1/8	7	.940	.994	.694	2	2.31	2	2.83
1 1/4	7	1.06	1.23	.890	2 1/4	2.60	2 1/4	3.18
1 3/8	6	1.16	1.48	1.06	2 1/2	2.89	2 3/4	3.89
1 1/2	6	1.28	1.77	1.29	2 3/4	3.18	3	4.24
1 5/8	5 1/2	1.39	2.07	1.51	3	3.46	3 1/4	4.60
1 3/4	5	1.49	2.40	1.74	3 1/4	3.75	3 1/2	4.95
1 7/8	5	1.61	2.76	2.05	3 1/2	4.04	3 3/4	5.30
2	4 1/2	1.71	3.14	2.30	3 1/2	4.04	4	5.66
2 1/4	4 1/2	1.96	3.98	3.02	3 3/4	4.33	4 1/4	6.01
2 1/2	4	2.17	4.91	3.71	4 1/4	4.91	4 1/2	6.36
2 3/4	4	2.42	5.94	4.60	4 1/2	5.20	4 3/4	6.72
3	3 1/2	2.63	7.07	5.43	4 3/4	5.48	5	7.07
3 1/4	3 1/2	2.88	8.30	6.51	5	5.77	5 1/2	7.78
3 1/2	3 1/4	3.10	9.62	7.55	5 1/4	6.06	5 3/4	8.13
3 3/4	3	3.32	11.04	8.64	5 3/4	6.64	6 1/4	8.84
4	3	3.57	12.57	10.00	6 1/4	7.22	6 3/4	9.55
4 1/4	2 7/8	3.80	14.19	11.33	6 1/2	7.50	7	9.90
4 1/2	2 3/4	4.03	15.90	12.74	7	8.08	7 1/2	10.61
4 3/4	2 5/8	4.25	17.72	14.23	7 1/4	8.37	7 3/4	10.96
5	2 1/2	4.48	19.63	15.76	7 3/4	8.95	8 1/4	11.66
5 1/2	2 3/8	4.95	23.76	19.17	8 1/2	9.81	9	12.72
6	2 1/4	5.42	28.27	23.10	9 1/4	10.67	9 3/4	13.79

ROUND CAST WASHERS



Size of Bolt Inches	A Inches	B Inches	C Inches	D Inches	Weight Per 100
1/2	5/8	2	1 1/4	3/8	21
5/8	3/4	2 1/2	1 1/2	1/2	43
3/4	7/8	3	2	5/8	70
7/8	1	3 1/2	2 1/4	3/4	113
1	1 1/8	4	2 5/8	7/8	175
1 1/8	1 1/4	4 1/2	2 7/8	1	256
1 1/4	1 3/8	5	3 1/4	1 1/8	332
1 3/8	1 1/2	5 1/2	3 1/2	1 1/4	455
1 1/2	1 5/8	6	3 3/4	1 3/8	610
1 5/8	1 3/4	6 1/2	4	1 7/16	737
1 3/4	2	7 1/4	4 1/4	1 1/2	865
1 7/8	2 1/8	7 1/2	4 1/2	1 9/16	990
2	2 1/4	7 1/2	4 3/4	1 5/8	1115
2 1/4	2 1/2	7 3/4	5	1 3/4	1350

WROUGHT IRON WASHERS



Size of Bolt Inches	Diameter Inches	Size of Hole Inches	Thickness Inches	Number in 100 lbs.
1/4	3/4	5/16	.065	13900
5/16	7/8	3/8	.065	11250
3/8	1	7/16	.083	6800
1/2	1 3/8	9/16	.109	2600
5/8	1 3/4	11/16	.134	1300
3/4	2	13/16	.134	1010
7/8	2 1/4	15/16	.148	869
1	2 1/2	1 1/16	.148	625
1 1/8	2 3/4	1 1/4	.148	520
1 1/4	3	1 3/8	.148	400
1 3/8	3 1/4	1 1/2	.165	300
1 1/2	3 1/2	1 5/8	.165	280
1 5/8	3 3/4	1 3/4	.165	240
1 3/4	4	1 7/8	.165	215
1 7/8	4 1/4	2	.165	190
2	4 1/2	2 1/8	.165	175

UPSET SCREW ENDS FOR ROUND BARS

Diameter of Bar	Area of Body of Bar	Diameter of Screw	Length of Upset	Area at Root of Thread	Number of Threads per Inch	Weight per Foot of Bar	Add for Upset
Inches	Sq. In.	Inches	Inches	Sq. In.		Pounds	Inches
½	.196	¾	4¼	.302	10	.668	6½
⅝	.307	⅞	4½	.420	9	1.043	5½
¾	.442	1	4½	.550	8	1.502	4½
⅞	.601	1¼	4¾	.893	7	2.044	6¼
1	.785	1⅜	5	1.057	6	2.670	5¼
1⅛	.994	1½	5	1.295	6	3.379	4¾
1¼	1.227	1⅝	5¼	1.515	5½	4.173	4½
1⅜	1.485	1¾	5¼	1.744	5	5.049	4
1½	1.767	2	5½	2.302	4½	6.008	5¼
1⅝	2.074	2⅛	5¾	2.650	4½	7.051	5
1¾	2.405	2¼	5¾	3.023	4½	8.178	4¾
1⅞	2.761	2⅜	6	3.419	4½	9.388	4½
2	3.142	2½	6	3.715	4	10.68	4¼
2⅛	3.547	2⅝	6¼	4.155	4	12.06	4
2¼	3.976	2⅞	6½	5.108	4	13.52	5¼
2⅜	4.430	3	6½	5.428	3½	15.07	4¾
2½	4.909	3⅛	6¾	5.957	3½	16.69	4¾
2⅝	5.412	3¼	6¾	6.510	3½	18.40	4½
2¾	5.940	3⅜	7	7.087	3½	20.20	4½
2⅞	6.492	3⅝	7¼	8.171	3¼	22.07	5¼
3	7.069	3¾	7¼	8.641	3	24.03	5
3⅛	7.670	3⅞	7½	9.305	3	26.08	5¼
3¼	8.296	4	7½	9.993	3	28.20	4¾
3⅜	8.946	4⅛	7¾	10.706	3	30.42	4¾
3½	9.621	4¼	8	11.329	2⅞	32.71	4½

UPSET SCREW ENDS FOR SQUARE BARS

Diameter of Side of Square Bar	Area of Body of Bar	Diameter of Screw	Length of Upset	Area at Root of Thread	Number of Threads per Inch	Weight per Foot of Bar	Add for Upset
Inches	Sq. Inches	Inches	Inches	Sq. Inches		Pounds	Inches
1/2	.25	3/4	4 1/4	.302	10	.850	4
5/8	.391	1	4 1/2	.550	8	1.328	5 3/4
3/4	.563	1 1/8	4 3/4	.694	7	1.913	4 1/2
7/8	.766	1 3/8	5	1.057	6	2.603	5 3/4
1	1.000	1 1/2	5	1.295	6	3.400	4 3/4
1 1/8	1.266	1 5/8	5 1/4	1.515	5 1/2	4.303	4 1/4
1 1/4	1.563	1 7/8	5 1/2	2.048	5	5.312	5 1/4
1 3/8	1.891	2	5 1/2	2.302	4 1/2	6.428	4 1/2
1 1/2	2.250	2 1/8	5 3/4	2.650	4 1/2	7.650	4 1/4
1 5/8	2.641	2 3/8	6	3.419	4 1/2	8.978	5
1 3/4	3.063	2 1/2	6	3.715	4	10.410	4 1/2
1 7/8	3.516	2 5/8	6 1/4	4.155	4	11.950	4 1/4
2	4.000	2 7/8	6 1/2	5.108	4	13.60	5
2 1/8	4.516	3	6 1/2	5.428	3 1/2	15.35	4 1/2
2 1/4	5.063	3 1/8	6 3/4	5.957	3 1/2	17.22	4 1/4
2 3/8	5.641	3 3/8	7	7.087	3 1/2	19.18	5 1/4
2 1/2	6.250	3 1/2	7	7.548	3 1/4	21.25	4 3/4
2 5/8	6.891	3 5/8	7 1/4	8.171	3 1/4	23.43	4 1/2
2 3/4	7.563	3 7/8	7 1/2	9.305	3	25.71	5 1/4
2 7/8	8.266	4	7 1/2	9.993	3	28.10	4 3/4
3	9.000	4 1/8	7 3/4	10.706	3	30.60	4 1/2
3 1/8	9.766	4 3/8	8	12.087	2 7/8	33.20	5 1/4
3 1/4	10.563	4 1/2	8	12.743	2 3/4	35.92	5
3 3/8	11.391	4 5/8	8 1/4	13.544	2 3/4	38.73	5
3 1/2	12.250	4 7/8	8 1/2	15.068	2 5/8	41.65	5 1/2

WEIGHTS and AREAS OF SQUARE and ROUND BARS

ONE CUBIC FOOT OF STEEL WEIGHING 489.6 LBS.

Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar	Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar
Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.	Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.
0	.....	.....	.....	.....	**2**	13.60	10.68	4.0000	3.1416
1/16	.013	.010	.0039	.0031	1/16	14.46	11.36	4.2539	3.3410
1/8	.053	.042	.0156	.0123	1/8	15.35	12.06	4.5156	3.5466
3/16	.119	.094	.0352	.0276	3/16	16.27	12.78	4.7852	3.7583
1/4	.212	.167	.0625	.0491	1/4	17.22	13.52	5.0625	3.9761
5/16	.333	.261	.0977	.0767	5/16	18.19	14.28	5.3477	4.2000
3/8	.478	.375	.1406	.1104	3/8	19.18	15.07	5.6406	4.4301
7/16	.651	.511	.1914	.1503	7/16	20.20	15.86	5.9414	4.6664
1/2	.850	.667	.2500	.1963	1/2	21.25	16.69	6.2500	4.9087
9/16	1.076	.845	.3164	.2485	9/16	22.33	17.53	6.5664	5.1572
5/8	1.328	1.043	.3906	.3068	5/8	23.43	18.40	6.8906	5.4119
11/16	1.608	1.262	.4727	.3712	11/16	24.56	19.29	7.2227	5.6727
3/4	1.913	1.502	.5625	.4418	3/4	25.71	20.20	7.5625	5.9396
13/16	2.245	1.763	.6602	.5185	13/16	26.90	21.12	7.9102	6.2126
7/8	2.603	2.044	.7656	.6013	7/8	28.10	22.07	8.2656	6.4918
15/16	2.989	2.347	.8789	.6903	15/16	29.34	23.04	8.6289	6.7771
1	3.400	2.670	1.0000	.7854	**3**	30.60	24.03	9.0000	7.0686
1/16	3.838	3.014	1.1289	.8866	1/16	31.89	25.04	9.3789	7.3662
1/8	4.303	3.379	1.2656	.9940	1/8	33.20	26.08	9.7656	7.6699
3/16	4.795	3.766	1.4102	1.1075	3/16	34.55	27.13	10.160	7.9798
1/4	5.312	4.173	1.5625	1.2272	1/4	35.92	28.20	10.563	8.2958
5/16	5.857	4.600	1.7227	1.3530	5/16	37.31	29.30	10.973	8.6179
3/8	6.428	5.049	1.8906	1.4849	3/8	38.73	30.42	11.391	8.9462
7/16	7.026	5.518	2.0664	1.6230	7/16	40.18	31.56	11.816	9.2806
1/2	7.650	6.008	2.2500	1.7671	1/2	41.65	32.71	12.250	9.6211
9/16	8.301	6.520	2.4414	1.9175	9/16	43.14	33.90	12.691	9.9678
5/8	8.978	7.051	2.6406	2.0739	5/8	44.68	35.09	13.141	10.321
11/16	9.682	7.604	2.8477	2.2365	11/16	46.24	36.31	13.598	10.680
3/4	10.41	8.178	3.0625	2.4053	3/4	47.82	37.56	14.063	11.045
13/16	11.17	8.773	3.2852	2.5802	13/16	49.42	38.81	14.535	11.416
7/8	11.95	9.388	3.5156	2.7612	7/8	51.05	40.10	15.016	11.793
15/16	12.76	10.02	3.7539	2.9483	15/16	52.71	41.40	15.504	12.177

WEIGHTS AND AREAS OF SQUARE AND ROUND BARS

ONE CUBIC FOOT OF STEEL WEIGHING 489.6 POUNDS

Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar	Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar
Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.	Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.
4	54.40	42.73	16.000	12.566	**6**	122.4	96.14	36.000	28.274
1/16	56.11	44.07	16.504	16.962	1/16	125.0	98.14	36.754	28.866
1/8	57.85	45.44	17.016	13.364	1/8	127.6	100.2	37.516	29.465
3/16	59.62	46.83	17.535	13.772	3/16	130.2	102.2	38.285	30.069
1/4	61.41	48.24	18.063	14.186	1/4	132.8	104.3	39.063	30.680
5/16	63.23	49.66	18.598	14.607	5/16	135.5	106.4	39.848	31.296
3/8	65.08	51.11	19.141	15.033	3/8	138.2	108.5	40.641	31.919
7/16	66.95	52.58	19.691	15.466	7/16	140.9	110.7	41.441	32.548
1/2	68.85	54.07	20.250	15.904	1/2	143.6	112.8	42.250	33.183
9/16	70.78	55.59	20.816	16.349	9/16	146.5	114.9	43.066	33.824
5/8	72.73	57.12	21.391	16.800	5/8	149.2	117.2	43.891	34.472
11/16	74.70	58.67	21.973	17.257	11/16	152.1	119.4	44.723	35.125
3/4	76.71	60.25	22.563	17.721	3/4	154.9	121.7	45.563	35.785
13/16	78.74	61.84	23.160	18.190	13/16	157.8	123.9	46.410	36.450
7/8	80.81	63.46	23.766	18.665	7/8	160.8	126.2	47.266	37.122
15/16	82.89	65.10	24.379	19.147	15/16	163.6	128.5	48.129	37.800
5	85.00	66.76	25.000	19.635	**7**	166.6	130.9	49.000	38.485
1/16	87.14	68.44	25.629	20.129	1/16	169.6	133.2	49.879	39.175
1/8	89.30	70.14	26.266	20.629	1/8	172.6	135.6	50.766	39.871
3/16	91.49	71.86	26.910	21.135	3/16	175.6	137.9	51.660	40.574
1/4	93.72	73.60	27.563	21.648	1/4	178.7	140.4	52.563	41.282
5/16	95.96	75.37	28.223	22.166	5/16	181.8	142.8	53.473	41.997
3/8	98.23	77.15	28.891	22.691	3/8	184.9	145.3	54.391	42.718
7/16	100.5	78.95	29.566	23.221	7/16	188.1	147.7	55.316	43.445
1/2	102.8	80.77	30.250	23.758	1/2	191.3	150.2	56.250	44.179
9/16	105.2	82.62	30.941	24.301	9/16	194.4	152.7	57.191	44.918
5/8	107.6	84.49	31.641	24.850	5/8	197.7	155.2	58.141	45.664
11/16	110.0	86.38	32.348	25.406	11/16	200.9	157.8	59.098	46.415
3/4	112.4	88.29	33.063	25.967	3/4	204.2	160.3	60.063	47.173
13/16	114.9	90.22	33.785	26.535	13/16	207.6	163.0	61.035	47.937
7/8	117.4	92.17	34.516	27.109	7/8	210.8	165.6	62.016	48.707
15/16	119.9	94.14	35.254	27.688	15/16	214.2	168.2	63.004	49.483

DECIMAL EQUIVALENTS FOR VULGAR FRACTIONS

The figures in central columns give the decimal parts in inches of the fraction at the left in column marked inches, and decimal parts of one foot for inches and fractions of inches shown in column to the right, marked foot.

Example, $\frac{1}{8}$ inches=.1250 inches $1\frac{1}{2}$ inches=.1250 feet.

Inches	Decimal	Foot	Inches	Decimal	Foot	Inches	Decimal	Foot	Inches	Decimal	Foot
	.0052	$\frac{1}{16}$		.2552	$3\frac{1}{16}$		.5052	$6\frac{1}{16}$		.7552	$9\frac{1}{16}$
	.0104	$\frac{1}{8}$		.2604	$3\frac{1}{8}$		.5104	$6\frac{1}{8}$		.7604	$9\frac{1}{8}$
$\frac{1}{64}$	.015625	$\frac{3}{16}$	$\frac{17}{64}$	.265625	$3\frac{3}{16}$	$\frac{33}{64}$	.515625	$6\frac{3}{16}$	$\frac{49}{64}$	.765625	$9\frac{3}{16}$
	.0208	$\frac{1}{4}$		.2708	$3\frac{1}{4}$		.5208	$6\frac{1}{4}$		.7708	$9\frac{1}{4}$
	.0260	$\frac{5}{16}$		.2760	$3\frac{5}{16}$		.5260	$6\frac{5}{16}$		.7760	$9\frac{5}{16}$
$\frac{1}{32}$	.03125	$\frac{3}{8}$	$\frac{9}{32}$	.28125	$3\frac{3}{8}$	$\frac{17}{32}$	.53125	$6\frac{3}{8}$	$\frac{25}{32}$	.78125	$9\frac{3}{8}$
	.0364	$\frac{7}{16}$		.2865	$3\frac{7}{16}$		.5364	$6\frac{7}{16}$		.7865	$9\frac{7}{16}$
	.0417	$\frac{1}{2}$		.2917	$3\frac{1}{2}$		.5417	$6\frac{1}{2}$		.7917	$9\frac{1}{2}$
$\frac{3}{64}$	.046875	$\frac{9}{16}$	$\frac{19}{64}$	.296875	$3\frac{9}{16}$	$\frac{35}{64}$	.546875	$6\frac{9}{16}$	$\frac{51}{64}$	.796875	$9\frac{9}{16}$
	.0521	$\frac{5}{8}$		.3021	$3\frac{5}{8}$		.5521	$6\frac{5}{8}$		.8021	$9\frac{5}{8}$
	.0573	$\frac{11}{16}$		.3073	$3\frac{11}{16}$		.5573	$6\frac{11}{16}$		.8073	$9\frac{11}{16}$
$\frac{1}{16}$	.0625	$\frac{3}{4}$	$\frac{5}{16}$	.3125	$3\frac{3}{4}$	$\frac{9}{16}$	.5625	$6\frac{3}{4}$	$\frac{13}{16}$	.8125	$9\frac{3}{4}$
	.0677	$\frac{13}{16}$		3177	$3\frac{13}{16}$		.5677	$6\frac{13}{16}$		.8177	$9\frac{13}{16}$
	.0729	$\frac{7}{8}$		.3229	$3\frac{7}{8}$		.5729	$6\frac{7}{8}$		.8229	$9\frac{7}{8}$
$\frac{5}{64}$	.078125	$\frac{15}{16}$	$\frac{21}{64}$	.328125	$3\frac{15}{16}$	$\frac{37}{64}$	.578125	$6\frac{15}{16}$	$\frac{53}{64}$	.828125	$9\frac{15}{16}$
	.0833	1		.3333	4		.5833	7		.8333	10
	.0885	$1\frac{1}{16}$		.3385	$4\frac{1}{16}$		.5885	$7\frac{1}{16}$		.8385	$10\frac{1}{16}$
$\frac{3}{32}$	.09375	$1\frac{1}{8}$	$\frac{11}{32}$	.34375	$4\frac{1}{8}$	$\frac{19}{32}$	.59375	$7\frac{1}{8}$	$\frac{27}{32}$	.84375	$10\frac{1}{8}$
	.0990	$1\frac{3}{16}$		.3490	$4\frac{3}{16}$		.5990	$7\frac{3}{16}$		.8490	$10\frac{3}{16}$
	.1042	$1\frac{1}{4}$		.3542	$4\frac{1}{4}$		.6042	$7\frac{1}{4}$		.8542	$10\frac{1}{4}$
$\frac{7}{64}$	.109375	$1\frac{5}{16}$	$\frac{23}{64}$	.359375	$4\frac{5}{16}$	$\frac{39}{64}$	.609375	$7\frac{5}{16}$	$\frac{55}{64}$	.859375	$10\frac{5}{16}$
	.1146	$1\frac{3}{8}$		.3646	$4\frac{3}{8}$		.6146	$7\frac{3}{8}$		.8646	$10\frac{3}{8}$
	.1198	$1\frac{7}{16}$		.3698	$4\frac{7}{16}$		.6198	$7\frac{7}{16}$		.8698	$10\frac{7}{16}$
$\frac{1}{8}$	.1250	$1\frac{1}{2}$	$\frac{3}{8}$	.3750	$4\frac{1}{2}$	$\frac{5}{8}$	.6250	$7\frac{1}{2}$	$\frac{7}{8}$	.8750	$10\frac{1}{2}$
	.1302	$1\frac{9}{16}$		.3802	$4\frac{9}{16}$		.6302	$7\frac{9}{16}$		.8802	$10\frac{9}{16}$
	.1354	$1\frac{5}{8}$		.3854	$4\frac{5}{8}$		.6354	$7\frac{5}{8}$		.8854	$10\frac{5}{8}$
$\frac{9}{64}$	.140625	$1\frac{11}{16}$	$\frac{25}{64}$	.390625	$4\frac{11}{16}$	$\frac{41}{64}$	.640625	$7\frac{11}{16}$	$\frac{57}{64}$	.890625	$10\frac{11}{16}$
	.1458	$1\frac{3}{4}$		.3958	$4\frac{3}{4}$		.6458	$7\frac{3}{4}$		.8958	$10\frac{3}{4}$
	.1510	$1\frac{13}{16}$		.4010	$4\frac{13}{16}$		.6510	$7\frac{13}{16}$		.9010	$10\frac{13}{16}$
$\frac{5}{32}$	.15625	$1\frac{7}{8}$	$\frac{13}{32}$	.40625	$4\frac{7}{8}$	$\frac{21}{32}$	.65625	$7\frac{7}{8}$	$\frac{29}{32}$	.90625	$10\frac{7}{8}$
	.1615	$1\frac{15}{16}$		.4114	$4\frac{15}{16}$		.6615	$7\frac{15}{16}$		.9115	$10\frac{15}{16}$
	.1667	2		.4167	5		.6667	8		.9167	11
$\frac{11}{64}$	.171875	$2\frac{1}{16}$	$\frac{27}{64}$	.421875	$5\frac{1}{16}$	$\frac{43}{64}$	.671875	$8\frac{1}{16}$	$\frac{59}{64}$	.921875	$11\frac{1}{16}$
	.1771	$2\frac{1}{8}$		.4271	$5\frac{1}{8}$		.6771	$8\frac{1}{8}$		.9271	$11\frac{1}{8}$
	.1823	$2\frac{3}{16}$		.4323	$5\frac{3}{16}$		.6823	$8\frac{3}{16}$		.9323	$11\frac{3}{16}$
$\frac{3}{16}$	.1875	$2\frac{1}{4}$	$\frac{7}{16}$	.4375	$5\frac{1}{4}$	$\frac{11}{16}$	.6875	$8\frac{1}{4}$	$\frac{15}{16}$	.9375	$11\frac{1}{4}$
	.1927	$2\frac{5}{16}$		.4427	$5\frac{5}{16}$		.6927	$8\frac{5}{16}$		.9427	$11\frac{5}{16}$
	.1979	$2\frac{3}{8}$		.4479	$5\frac{3}{8}$		.6979	$8\frac{3}{8}$		.9479	$11\frac{3}{8}$
$\frac{13}{64}$	.203125	$2\frac{7}{16}$	$\frac{29}{64}$	.453125	$5\frac{7}{16}$	$\frac{45}{64}$	.703125	$8\frac{7}{16}$	$\frac{61}{64}$	.953125	$11\frac{7}{16}$
	.2083	$2\frac{1}{2}$		.4583	$5\frac{1}{2}$		.7083	$8\frac{1}{2}$		.9583	$11\frac{1}{2}$
	.2135	$2\frac{9}{16}$		.4635	$5\frac{9}{16}$		.7135	$8\frac{9}{16}$		.9635	$11\frac{9}{16}$
$\frac{7}{32}$	.21875	$2\frac{5}{8}$	$\frac{15}{32}$	.46875	$5\frac{5}{8}$	$\frac{23}{32}$	.71875	$8\frac{5}{8}$	$\frac{31}{32}$	.96875	$11\frac{5}{8}$
	.2240	$2\frac{11}{16}$		.4740	$5\frac{11}{16}$		.7240	$8\frac{11}{16}$		.9740	$11\frac{11}{16}$
	.2292	$2\frac{3}{4}$		.4792	$5\frac{3}{4}$		.7292	$8\frac{3}{4}$		.9792	$11\frac{3}{4}$
$\frac{15}{64}$	.234375	$2\frac{13}{16}$	$\frac{31}{64}$	.484375	$5\frac{13}{16}$	$\frac{47}{64}$	.734375	$8\frac{13}{16}$	$\frac{63}{64}$	.984375	$11\frac{13}{16}$
	.2395	$2\frac{7}{8}$		.4896	$5\frac{7}{8}$		.7396	$8\frac{7}{8}$		.9896	$11\frac{7}{8}$
	.2448	$2\frac{15}{16}$		.4948	$5\frac{15}{16}$		.7448	$8\frac{15}{16}$		.9948	$11\frac{15}{16}$
$\frac{1}{4}$	.25000	3	$\frac{1}{2}$	.5000	6	$\frac{3}{4}$	.7500	9	**1**	1.0600	12

WEIGHT OF BUILDING MATERIAL, ETC.

KIND OF MATERIAL	Weight per Cubic Foot lbs.
Asphalt, pavement composition	100
Brick, best pressed	135-150
" common hard	110-125
" fire	140-150
" paving	150
Brickwork, pressed brick	120-140
" common hard brick	110-120
Cement, American, Portland, loose	85
Coal, anthracite, broken, loose	56
" bituminous, broken, loose	54
Concrete, cinder	72
" broken stone	120-140
Glass	160
Gravel	120
Iron, Cast	450
" Wrought	480
Masonry, granite or marble ashlar	160
" limestone ashlar	150
" sandstone ashlar	140
Mortar	100
Plaster Ceilings, 10 to 15 lbs. per square foot	.....
Plaster of Paris	140
Sand, clay and earth, dry	100
" " " " wet	120
Snow, freshly fallen	10
" saturated with moisture	20-50
Steel	490
Stone: Bluestone	160
" Granite	170
" Limestone	160
" Marble	165
" Sandstone	145
" Slate	175
Terra Cotta	110
" " Masonry	100
Timber: Douglas Fir	30
" Hemlock	26
" Southern Yellow Pine	45-48
" Spruce	25-28
" White Oak	48-52
" White Pine	25-28

ALLOWABLE UNIT STRESSES AND LOADS

In Accordance with the Building Laws of Various Cities

COMPRESSION DIRECT	Revised to 1906				
	St. Paul	New York	Chicago	Philadelphia	Boston
	Pounds per Square Inch				
Rolled steel	16000	16000	.....	16250	.....
Cast steel	16000	16000	.....	.....	8000
Wrought iron	12000	12000	.....	12500	.....
Cast iron (in short blocks)	16000	16000	.....	17500	.....
Steel pins and rivets (bearing)	18000	20000	20000	.....	18000
Wrought iron pins and rivets (bearing)	15000	15000	15000	.....	15000
Oak ..... with grain	1000	900	.....	.....	.....
Oak ..... across "	700	800	.....	.....	250
Yellow pine, Washington or Oregon fir, with "	1100	1000	.....	750	.....
Yellow pine, Washington or Oregon fir, across "	600	600	.....	91⅔	250
White pine ..... with "	900	800	.....	.....	.....
White pine ..... across "	300	400	.....	.....	150
Spruce ..... with "	800	800	.....	500	.....
Spruce ..... across "	400	400	.....	50	150
Locust ..... with "	1200	1200	.....	.....	.....
Locust ..... across "	1000	1000	.....	.....	.....
Hemlock ..... with "	800	500	.....	350	.....
Hemlock ..... across "	300	500	.....	41⅔	.....
Chestnut ..... with "	500	500	.....	.....	.....
Chestnut ..... across "	1000	1000	.....	.....	.....
Concrete (Portland) cement, 1; sand, 2; stone, 4	230	230	55	208	.....
Concrete (Portland) cement, 1; sand, 2; stone, 5	208	208	55	208	.....
Concrete (Rosendale or equal) cement, 1; sand, 2; stone, 4	125	125	55	208	.....
Concrete (Rosendale or equal) cement, 1; sand, 2; stone, 5	111	111	55	208	.....
Rubble stonework in Portland cement mortar	140	140	.....	139	.....
Rubble stonework in Rosendale cement mortar	111	111	.....	139	.....
Rubble stonework in lime and cement mortar	97	97	.....	111	.....
Rubble stonework in lime mortar	70	70	.....	69½	.....
Brickwork in Portland cement mortar, cement, 1; sand, 3	250	250	.....	208	.....
Brickwork in Rosendale or equal, cement mortar, cement, 1; sand, 3	208	208	.....	208	.....
Brickwork in lime and cement mortar, cement, 1; lime, 1; sand, 3	160	160	.....	167	.....
Brickwork in lime mortar, lime, 1; sand, 4	111	111	.....	111	.....
Granites (according to test)	1000 to 2000	1000 to 2000	.....	.....	.....
Limestones (according to test)	700 " 2300	700 " 2300	.....	.....	.....
Marbles (according to test)	600 " 1200	600 " 1200	.....	.....	.....
TENSION DIRECT.					
Rolled steel	16000	16000	15000	16250	15000
Cast steel	16000	16000	.....	.....	.....
Wrought iron	12000	12000	12000	12500	12000
Cast iron	3000	3000	.....	.....	.....
Yellow pine, Washington and Oregon fir	1200	1200	.....	1800	.....
White pine	800	800	.....	.....	.....
Spruce	800	800	.....	1250	.....
Oak	1000	1000	.....	.....	.....
Hemlock	600	600	.....	1000	.....

ALLOWABLE UNIT STRESSES AND LOADS

In Accordance with the Building Laws of Various Cities

	Revised to 1906				
SHEAR	St. Paul	New York	Chicago	Philadelphia	Boston
	Pounds Per Square Inch				
Steel plates	9000	9000	.....	10000	10000
Steel shop rivets and pins	10000	10000	10000	10000	10000
Steel field rivets	8000	8000	10000	10000	10000
Steel field bolts	7000	7000	.....	10000	10000
Yellow pine ... with fiber	70	70	100	66⅔	100
Yellow pine ... across "	500	500	250	750	.....
White pine ... with "	50	40	80	.....	80
White pine ... across "	250	250	150	.....	.....
Spruce ... with "	50	50	80	50	80
Spruce ... across "	320	320	150	500	.....
Oak ... with "	100	100	150	.....	150
Oak ... across "	600	600	250	.....	.....
Locust ... with "	100	100	.....	.....	.....
Locust ... across "	720	720	.....	.....	.....
Hemlock ... with "	40	40	.....	41⅔	.....
Hemlock ... across "	275	275	.....	416⅔	.....
Chestnut ... across "	150	150	.....	.....	.....
SAFE EXTREME FIBER STRESS, BENDING					
Rolled steel beams	16000	16000	16000	.....	16000
Rolled steel pins, rivets and bolts	20000	20000	22500	.....	22500
Riveted steel beams (net flange section)	14000	14000	15000	.....	.....
Cast iron, compression side	16000	16000	.....	.....	8000
Cast iron, tension side	3000	3000	2500	3750	2500
Yellow pine, Washington or Oregon fir	1500	1200	1250	1600	1250
White pine	1000	800	750	.....	750
Spruce	1000	800	750	1100	750
Oak	1000	1000	1000	.....	1000
Locust	1200	1200	.....	.....	.....
Hemlock	600	600	.....	900	.....
Chestnut	800	800	.....	.....	.....
Granite	180	180	.....	.....	.....
Limestone	150	150	.....	.....	.....
Slate	400	400	.....	.....	.....
Marble	120	120	.....	.....	.....
Sandstone	100	100	.....	.....	.....
Concrete (Portland) cement, 1; sand, 2; stone, 4	30	30	.....	.....	.....
Concrete (Portland) cement, 1; sand, 2; stone, 5	20	20	.....	.....	.....
Concrete (Rosendale or equal) cement, 1; sand, 2; stone, 4	16	16	.....	.....	.....
Concrete (Rosendale or equal) cement, 1; sand, 2; stone, 5	10	10	.....	.....	.....
Brick (common)	50	50	.....	.....	.....
Brick (in cement)	30	30	.....	.....	.....

SAFE LOADS IN POUNDS

UNIFORMLY DISTRIBUTED FOR RECTANGULAR WOODEN BEAMS OF WHITE PINE

Allowable fiber stress 800 pounds per square inch. Factor of safety, 5. Loads given include weight of beams.

For Southern or Long Leaf Yellow Pine multiply tabular load by 1½.
For Washington Fir multiply tabular load by 1⅓.
For Northern or Short Leaf Yellow Pine multiply tabular load by 1⅛.

Span in Feet	6	8	10	12	14	16	18	20	22	24
Size of Beam										
2 x 4	474	355	285	223	203	177	158	142		
2 x 6	1070	800	640	535	455	400	355	320	290	265
2 x 8	1900	1430	1140	950	815	715	630	570	520	475
2 x 10	2960	2220	1775	1480	1270	1110	985	885	800	740
2 x 12	4280	3200	2560	2140	1820	1600	1420	1280	1160	1060
2 x 14	5800	4350	3480	2900	2490	2180	1940	1740	1580	1450
3 x 10	4440	3340	2660	2220	1890	1660	1480	1330	1210	1110
3 x 12	6400	4800	3840	3200	2750	2400	2130	1920	1745	1600
3 x 14	8700	6530	5220	4350	3730	3270	2910	2610	2370	2170
3 x 16	11380	8530	6820	5700	4870	4270	3790	3410	3100	2850
4 x 10	5925	4440	3550	2960	2540	2220	1970	1770	1600	1480
4 x 12	8560	6400	5120	4280	3640	3200	2840	2560	2320	2120
4 x 14	11600	8700	6960	5800	4980	4360	3880	3480	3160	2900
4 x 16	15170	11380	9100	7600	6500	5700	5050	4550	4130	3800
6 x 10	8880	6680	5320	4440	3800	3320	2960	2660	2420	2220
6 x 12	12800	9600	7680	6400	5480	4800	4260	3840	3490	3200
6 x 14	17420	13070	10440	8700	7470	6540	5820	5220	4740	4350
6 x 16	22760	17060	13640	11400	9750	8550	7580	6820	6200	5700
6 x 18	28800	21600	17280	14400	12350	10800	9600	8640	7850	7200
8 x 10	11900	8900	7100	5900	5100	4400	3900	3500	3200	3000
8 x 12	17100	12800	10200	8600	7300	6400	5700	5100	4600	4200
8 x 14	23200	17400	13900	11600	10000	8700	7800	7000	6300	5800
8 x 16	30300	22800	18200	15200	13000	11400	10100	9100	8300	7600
8 x 18	38400	28800	23000	19200	16500	14400	12800	11500	10500	9600
10 x 10	14800	11100	8900	7400	6400	5600	4900	4400	4000	3700
10 x 12	21400	16000	12800	10700	9100	8050	7100	6400	5800	5300
10 x 14	29000	21800	17400	14500	12500	10900	9700	8700	7900	7300
10 x 16	37900	28500	22800	19000	16300	14300	12600	11400	10300	9500
10 x 18	48000	36000	28800	24000	20600	18000	16000	14400	13100	12000
12 x 12	25600	19200	15400	12800	11000	9600	8500	7700	7000	6400
12 x 14	34800	26100	20900	17400	14900	13100	11600	10500	9500	8700
12 x 16	45500	34100	27300	22800	19500	17100	15200	13600	12400	11400
12 x 18	57600	43200	34600	28800	24700	21600	19200	17300	15700	14400
12 x 20	71100	53300	42700	35600	30500	26700	23700	21400	19400	17800
14 x 14	40700	30500	24400	20300	17400	15300	13600	12200	11100	10200
14 x 16	53100	39800	31800	26600	22800	20000	17700	15900	14500	13300
14 x 18	67200	50400	40300	33600	28800	25200	22400	20200	18300	16800
14 x 20	83000	62200	49800	41500	35600	31100	27700	24900	22600	20800

SAFE LOADS IN POUNDS

FOR RECTANGULAR WOOD PILLARS OF WHITE PINE

Based on the Formula of A. L. Johnson, C. E., United States Department of Agriculture, Division of Forestry

$$P = F \times \frac{700 + 15c}{700 + 15c + c^2}$$

P = Ultimate strength in pounds per square inch. F = Ultimate crushing strength of timber.

$c = \frac{\mathit{f}}{d}$. f = Length of pillar in inches. d = Least diameter in inches.

Southern or Long Leaf Yellow Pine = Tabular Load × 1⅜.
Northern or Short Leaf Yellow Pine = " " × 1¼.
Washington Fir ..... = " " × 1⅛.

Size of Pillar	6 x 6	8 x 8	9 x 9	10 x 10	12 x 12	14 x 14	16 x 16
Length in Feet							
6	21600	40800	52600	65800	96400	132700	174600
7	20800	39700	51400	64600	95000	131200	173000
8	19800	38400	50000	63200	93400	129600	171400
9	18900	37200	48800	61600	91800	127800	169600
10	18000	36000	47400	60200	90200	126000	167600
11	17200	34800	45000	58600	88400	124200	165400
12	16400	33500	44600	57080	86600	122000	163200
13	15500	32400	43200	55520	84800	120000	161200
14	14800	31200	41800	54000	83000	118000	158800
15	14200	30000	40500	52480	81100	115900	156400
16	13500	29000	39200	50980	79200	113600	154000
17	12900	27900	37900	49500	77400	111400	151600
18	12300	27000	36800	48080	75600	109300	149000
19	11800	26000	35500	46700	73800	107000	146600
20	11300	25100	34400	45400	72000	105000	144000
21	10800	24300	33400	44000	70200	102900	141800
22	10400	23400	32400	42800	68600	100800	139200
23	10000	22700	31300	41580	66800	98700	136800
24	9600	21900	30400	40400	65400	96600	134000

SPIKES AND NAILS

STANDARD STEEL WIRE NAILS						STEEL WIRE SPIKES			COMMON IRON NAILS		
Size	Length	Common		Finishing		Length	Diam. Inches	No. Per Pound	Size	Length	No. Per Pound
		Diam. Inches	No. Per Pound	Diam. Inches	No. Per Pound						
2d	1 ″	.0524	1030	.0453	1558	3 ″	.1620	41	**2d**	1 ″	800
3d	1¼″	.0588	640	.0508	913	3½″	.1819	30	**3d**	1¼″	400
4d	1½″	.0720	380	.0508	761	4 ″	.2043	23	**4d**	1½″	300
5d	1¾″	.0764	275	.0571	500	4½″	.2294	17	**5d**	1¾″	200
6d	2 ″	.0808	210	.0641	350	5 ″	.2576	13	**6d**	2 ″	150
7d	2¼″	.0858	160	.0641	315	5½″	.2893	11	**7d**	2¼″	120
8d	2½″	.0935	115	.0720	214	6 ″	.2893	10	**8d**	2½″	85
9d	2¾″	.0963	93	.0720	195	6½″	.2249	7½	**9d**	2¾″	75
10d	3 ″	.1082	77	.0808	137	7 ″	.2249	7	**10d**	3 ″	60
12d	3¼″	.1144	60	.0808	127	8 ″	.3648	5	**12d**	3¼″	50
16d	3½″	.1285	48	.0907	90	9 ″	.3648	4½	**16d**	3½″	40
20d	4 ″	.1620	31	.1019	62	.....	.....	.....	**20d**	4 ″	20
30d	4½″	.1819	22	.....	.....	.....	.....	.....	**30d**	4½″	16
40d	5 ″	.2043	17	.....	.....	.....	.....	.....	**40d**	5 ″	14
50d	5½″	.2294	13	.....	.....	.....	.....	.....	**50d**	5½″	11
60d	6 ″	.2576	11	.....	.....	.....	.....	.....	**60d**	6 ″	8

WOOD SCREWS

Diameter = Number x 0.01325 + 0.056

No.	Diam.	Diam.	No.	Diam.	Diam.	No.	Diam.	Diam.	No.	Diam.	Diam.	No.	Diam.	Diam.
0	.056	7/128″	**6**	.135	17/128″	**12**	.215	7/32″	**18**	.293	19/64″	**24**	.374	3/8″
1	.069	9/128″	**7**	.149	19/128″	**13**	.228	29/128″	**19**	.308	39/128″	**25**	.387	49/128″
2	.082	11/128″	**8**	.162	21/128″	**14**	.241	33/128″	**20**	.321	41/128″	**26**	.401	51/128″
3	.096	13/128″	**9**	.175	11/64″	**15**	.255	1/4″	**21**	.334	43/128″	**27**	.414	53/128″
4	.109	7/64″	**10**	.188	3/16″	**16**	.268	17/64″	**22**	.347	45/128″	**28**	.427	55/128″
5	.122	1/8″	**11**	.201	13/64″	**17**	.281	9/32″	**23**	.361	23/64″	**29**	.440	57/128″
												30	.453	29/64″

BREAKING STRENGTH OF ROPES

MANILA, NEW			STEEL WIRE ROPE*					
			6 Strands, 19 Wires Per Strand—Hemp Center					
			CRUCIBLE STEEL			PLOW STEEL		
Diam.	Brk. Str. Pounds	Feet in Pound	Breaking Weight	Proper W'king ld.	Weight 100 Feet	Diam.	Breaking Weight	Proper W'king ld.	Weight 100 Feet
½″	2000	14							
5/8″	4000	6							
¾″	6000	4							
7/8″	7000	3¼	9000 lbs.	1500 lbs.	26	3/8″	16000lbs.	3000 lbs.	26
1 ″	11000	2⅛	15000 lbs.	2000 lbs.	35	½″	24000 lbs.	5000 lbs.	35
1¼″	16000	1½	28000 lbs.	4000 lbs.	63	5/8″	40000 lbs.	7000 lbs.	63
1½″	24000	1	36000 lbs.	6000 lbs.	88	¾″	54000 lbs.	10000 lbs.	88
1¾″	27000	10 in.	50000 lbs.	10000 lbs.	120	7/8″	74000 lbs.	14000 lbs.	120
2 ″			66000 lbs.	12000 lbs.	158	1 ″	100000 lbs.	18000 lbs.	158
.....	.....	.....	84000 lbs.	16000 lbs.	200	1⅛″	126000 lbs.	24000 lbs.	200
.....	.....	.....	104000 lbs.	20000 lbs.	250	1¼″	152000 lbs.	30000 lbs.	250

* American Hoist & Derrick Co's Standard.

EXTRACTS FROM MANUFACTURERS' STANDARD SPECIFICATIONS

MEDIUM STEEL

PROCESS OF MANUFACTURE

1. Steel may be made by either the Open-hearth or Bessemer process.

FINISH

2. Finished bars must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

CHEMICAL PROPERTIES

3. Steel for Railway Bridges. } Maximum Phosphorus .08 per cent.

Steel for Buildings, Train Sheds, Highway Bridges and similar structures. } Maximum Phosphorus .10 per cent.

PHYSICAL PROPERTIES

4. Ultimate strength, 60,000 to 70,000 pounds per square inch.
Elastic limit, not less than one-half the ultimate strength.
Elongation, 22 per cent.

Bending test, 180 degrees to a diameter equal to thickness of piece tested without fracture on outside of bent portion.

WORKMANSHIP

1. All workmanship must be first class. All abutting surfaces of compression members, except flanges of plate girders where the joints are fully spliced, must be planed or turned to even bearings so that they shall be in such contact throughout as may be obtained by such means. All finished surfaces must be protected by white lead and tallow.

2. The rivet holes for splice plates of abutting members shall be so accurately spaced that when the members are brought into position the holes shall be truly opposite before the rivets are driven.

RIVETS

3. The pitch of rivets in all classes of work shall never exceed 6 inches, nor 16 times the thinnest outside plate, nor be less than 3 diameters of the rivet. The rivets used shall generally be $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{7}{8}$ inch diameter. The distance between the edge of any piece and the center of a rivet hole must never be less than $1\frac{1}{4}$ inches, except for bars less than $2\frac{1}{2}$ inches wide. When practicable it shall be at least two diameters of the rivet. Rivets must completely fill the holes, have full heads concentric with the rivet, of a height not less than .6 the diameter of the rivet, and in full contact with the surface, or be countersunk when so required, and machine-driven wherever practicable.

PUNCHING

4. The diameter of the punch shall not exceed by more than 1-16 inch the diameter of the rivets to be used, and all holes must be clean cuts without torn or ragged edges. Rivet holes must be accurately spaced; the use of drift pins will be allowed only for bringing together the several parts forming a member, and they must not be driven with such force as to disturb the metal about the holes.

Built members must, when finished, be true and free from twists, kinks, buckles, or open joints between the component pieces.

PAINTING

5. All surfaces inaccessible after assembling must be well painted or oiled before the parts are assembled.

STRUCTURAL CAST IRON

1. Except where chilled iron is specified, all castings shall be tough gray iron, free from injurious cold-shuts or blow-holes, true to pattern, and of a workmanlike finish. Sample pieces, one inch square, cast from the same heat of metal in sand moulds, shall be capable of sustaining on a clear span of 4 feet 8 inches a central load of 500 pounds when tested in the rough bar.

MENSURATION

LENGTH

Circumference of circle = diameter × 3.1416 or diameter × $3\frac{1}{7}$ approx.
Diameter of circle = circumference × .3183 or $\frac{7}{22}$ of circumference approx.
Side of square of equal periphery as circle = diameter × .7854.
Diameter of circle of equal periphery as square = side × 1.2732.
Side of inscribed square = diameter of circle × .7071.
Length of arc = No. of degrees × diameter × .008727.
Radius = .5642 $\sqrt{}$ area.

AREA OF REGULAR POLYGONS

Regular polygon = sum of sides × half perpendicular distance from center to sides.
Square the length of one side and multiply by proper number in following table.

Name	No. of sides	Multiply
Triangle	3	.433
Square	4	1.
Pentagon	5	1.720
Hexagon	6	2.598
Heptagon	7	3.634
Octagon	8	4.828
Nonagon	9	6.182
Decagon	10	7.694

Triangle = base × ½ perpendicular height.
Trapezoid = half the sum of parallel sides × perpendicular height.
Circle = diameter squared × 0.7854.
= circumference squared × .07958.
Ring = .7854 × [square of inside diameter — square of outside diameter].
Sector of circle = Length of arc × ½ radius.
Segment of circle = Area of sector — area of triangle when the segment is less and + the area of the triangle when segment is greater than semicircle.
Side of square that shall equal area of circle = diameter × .8862; circumference × .2821.
Diameter of circle that shall equal area of square = side of square × 1.1284.
Parabola = base × ⅔ height.
Ellipse = long diameter × short diameter × .7854.
Surface of cylinder = circumference × height + area of both ends.
Surface of sphere = diameter squared × 3.1416, or = circumference × diameter.

SOLID CONTENTS

Prism = area of base × perpendicular height.
Cylinder = area of section at right angle to side × length of side.
Sphere = diameter cubed × .5236.
= surface × ⅙ diameter.
Pyramid or Cone = area of base × ⅓ perpendicular height.

PART II

(Pages 99 to 140)

DEVOTED TO

BETHLEHEM STRUCTURAL STEEL SECTIONS

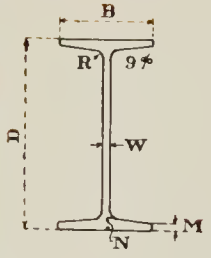
CONTAINING

TABLES OF DIMENSIONS, PROPERTIES AND SAFE LOADS OF BETHLEHEM SPECIAL I BEAMS, GIRDER BEAMS, AND H COLUMNS.

AND

DETAIL DIMENSIONS AND CONNECTION ANGLES TAKEN FROM BETHLEHEM STEEL CO.'S HANDBOOK, EDITION OF 1909 AND PUBLISHED WITH THEIR PERMISSION.

We carry a large stock of Bethlehem sections for immediate delivery.



WEIGHTS AND DIMENSIONS OF

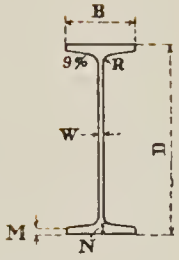
BETHLEHEM

GIRDER BEAMS

Section Number	Weight per Foot, Pounds	DIMENSIONS, IN INCHES					
		Depth *D*	Flange Width *B*	Web Thickness *W*	Flange Thickness		Radius of Fillet *R*
					At Edge *M*	At Root *N*	
G30a	200.0	30	15.00	.750	0.950	1.591	.90
G30	180.0	30	13.00	.690	1.035	1.589	.90
G28a	180.0	28	14.35	.690	0.920	1.535	.85
G28	165.0	28	12.50	.660	1.000	1.533	.85
G26a	160.0	26	13.60	.630	0.885	1.469	.80
G26	150.0	26	12.00	.630	0.955	1.469	.80
G24a	140.0	24	13.00	.600	0.800	1.358	.70
G24	120.0	24	12.00	.530	0.730	1.246	.70
G20a	140.0	20	12.50	.640	0.930	1.464	.75
G20	112.0	20	12.00	.550	0.695	1.210	.65
G18	92.0	18	11.50	.480	0.590	1.087	.60
G15b	140.0	15	11.75	.800	1.090	1.583	.95
G15a	104.0	15	11.25	.600	0.770	1.249	.75
G15	73.0	15	10.50	.430	0.520	0.974	.55
G12a	70.0	12	10.00	.460	0.575	1.004	.55
G12	55.0	12	9.75	.370	0.415	0.837	.45
G10	44.0	10	9.00	.310	0.370	0.763	.40
G9	38.0	9	8.50	.300	0.335	0.704	.40
G8	32.5	8	8.00	.290	0.295	0.642	.40

WEIGHTS AND DIMENSIONS OF

BETHLEHEM I BEAMS.



Section Number	Weight per Foot, Pounds	Depth *D*	DIMENSIONS, IN INCHES				Radius of Fillet *R*
			Flange Width *B*	Web Thickness *W*	Flange Thickness		
					At Edge *M*	At Root *N*	
B30	120.0	30	10.500	.540	.735	1.183	.65
B28	105.0	28	10.000	.500	.675	1.102	.60
B26	90.0	26	9.500	.460	.600	1.007	.55
B24a	84.0	24	9.250	.460	.585	.980	.55
B24	83.0	24	9.130	.520	.510	.897	.50
	73.0	24	9.000	.390	.510	.897	.50
B20a	82.0	20	8.890	.570	.580	.955	.55
	72.0	20	8.750	.430	.580	.955	.55
B20	69.0	20	8.145	.520	.475	.818	.45
	64.0	20	8.075	.450	.475	.818	.45
	59.0	20	8.000	.375	.475	.818	.45
B18	59.0	18	7.675	.495	.430	.753	.40
	54.0	18	7.590	.410	.430	.753	.40
	52.0	18	7.555	.375	.430	.753	.40
	48.5	18	7.500	.320	.430	.753	.40
B15b	71.0	15	7.500	.520	.785	1.099	.60
B15a	64.0	15	7.195	.605	.590	.887	.50
	54.0	15	7.000	.410	.590	.887	.50
B15	46.0	15	6.810	.440	.400	.686	.40
	41.0	15	6.710	.340	.400	.686	.40
	38.0	15	6.660	.290	.400	.686	.40
B12a	36.0	12	6.300	.310	.440	.710	.40
B12	32.0	12	6.205	.335	.330	.594	.35
	28.5	12	6.120	.250	.330	.594	.35
B10	28.5	10	5.990	.390	.270	.522	.30
	23.5	10	5.850	.250	.270	.522	.30
B9	24.0	9	5.555	.365	.245	.479	.30
	20.0	9	5.440	.250	.245	.479	.30
B8	19.5	8	5.325	.325	.205	.430	.30
	17.5	8	5.250	.250	.205	.430	.30

PROPERTIES OF

BETHLEHEM GIRDER BEAMS.

Section. Number	Depth of Beam, Inches	Weight per Foot, Pounds	Area of Section, Square Inches	Thickness of Web, Inches	Width of Flange, Inches	Increase of Web and Flange for each lb. Increase of Weight, Inches.	NEUTRAL AXIS PERPENDICULAR TO WEB AT CENTER		
							Moment of Inertia *I*	Radius of Gyration *R*	Section Modulus *S*
G30a	30	200.0	58.71	.750	15.00	.010	9150.6	12.48	610.0
G30	30	180.0	53.00	.690	13.00	.010	8194.5	12.43	546.3
G28a	28	180.0	52.86	.690	14.35	.011	7264.7	11.72	518.9
G28	28	165.0	48.47	.660	12.50	.011	6562.7	11.64	468.8
G26a	26	160.0	46.91	.630	13.60	.011	5620.8	10.95	432.4
G26	26	150.0	43.94	.630	12.00	.011	5153.9	10.83	396.5
G24a	24	140.0	41.16	.600	13.00	.012	4201.4	10.10	350.1
G24	24	120.0	35.38	.530	12.00	.012	3607.3	10.10	300.6
G20a	20	140.0	41.19	.640	12.50	.015	2934.7	8.44	293.5
G20	20	112.0	32.81	.550	12.00	.015	2342.1	8.45	234.2
G18	18	92.0	27.12	.480	11.50	.016	1591.4	7.66	176.8
G15b	15	140.0	41.27	.800	11.75	.020	1592.7	6.21	212.4
G15a	15	104.0	30.50	.600	11.25	.020	1220.1	6.32	162.7
G15	15	73.0	21.49	.430	10.50	.020	883.4	6.41	117.8
G12a	12	70.0	20.58	.460	10.00	.025	538.3	5.12	89.8
G12	12	55.0	16.18	.370	9.75	.025	432.0	5.17	72.0
G10	10	44.0	12.95	.310	9.00	.030	244.2	4.34	48.8
G9	9	38.0	11.22	.300	8.50	.033	170.9	3.90	38.0
G8	8	32.5	9.54	.290	8.00	.037	114.4	3.46	28.6

W = Safe load in pounds, uniformly distributed, including weight of beam.

L = Span, in feet. M = Moment of forces, in foot pounds.

PROPERTIES OF
BETHLEHEM GIRDER BEAMS.

Coefficients of Strength.				Maximum Safe Shear on Web, in Pounds.	Neutral Axis Coincident with Center Line of Web.		Section Number.
For Fiber Stress of 16,000 Lbs. per Sq. In. for Buildings. C	Add for each Lb. Increase in Weight of Beam.	For Fiber Stress of 12,500 Lbs. per Sq. In. for Moving Loads. C'	Add for each Lb. Increase in Weight of Beam.		Moment of Inertia. I'	Radius of Gyration. r'	
6,507,100	15,690	5,083,700	12,270	189,300	630.2	3.28	**G30a**
5,827,200	15,690	4,552,500	12,270	165,200	433.3	2.86	**G30**
5,535,000	14,640	4,324,200	11,450	161,500	533.3	3.18	**G28a**
5,000,100	14,640	3,906,400	11,450	150,300	371.9	2.77	**G28**
4,611,900	13,600	3,603,100	10,630	135,900	435.7	3.05	**G26a**
4,228,800	13,600	3,303,800	10,630	135,900	314.6	2.68	**G26**
3,734,600	12,550	2,917,600	9,820	121,700	346.9	2.90	**G24a**
3,206,500	12,550	2,505,100	9,820	98,500	249.4	2.66	**G24**
3,130,300	10,460	2,445,600	8,180	124,200	348.9	2.91	**G20a**
2,498,300	10,460	1,951,800	8,180	98,500	239.3	2.70	**G20**
1,886,100	9,410	1,473,500	7,360	76,100	182.6	2.59	**G18**
2,265,200	7,840	1,769,700	6,140	134,200	331.0	2.83	**G15b**
1,735,300	7,840	1,355,700	6,140	94,300	213.0	2.64	**G15a**
1,256,600	7,840	981,600	6,140	59,200	123.2	2.39	**G15**
957,800	6,280	748,300	4,910	57,200	114.7	2.36	**G12a**
768,000	6,280	600,000	4,910	42,300	81.1	2.24	**G12**
521,000	5,230	407,000	4,090	29,800	57.3	2.10	**G10**
405,000	4,710	316,400	3,680	26,700	44.1	1.98	**G9**
305,100	4,180	238,300	3,270	23,600	32.9	1.86	**G8**

C and C′ = Coefficients given in the tables.

$$W = \frac{C \text{ or } C'}{L}; \qquad M = \frac{C \text{ or } C'}{8}; \qquad C \text{ or } C' = WL = 8M = \tfrac{2}{3} f S.$$

PROPERTIES OF

BETHLEHEM I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.	Thickness of Web, Inches.	Width of Flange, Inches.	Increase of Web and Flange for each Lb. Increase of Weight, Inches.	Neutral Axis Perpendicular to Web at Center.		
							Moment of Inertia. *I*	Radius of Gyration. *r*	Section Modulus. *S*
B30	30	120.0	35.30	.540	10.500	.010	5239.6	12.18	349.3
B28	28	105.0	30.88	.500	10.000	.011	4014.1	11.40	286.7
B26	26	90.0	26.49	.460	9.500	.011	2977.2	10.60	229.0
B24a	24	84.0	24.80	.460	9.250	.012	2381.9	9.80	198.5
B24	24	83.0	24.59	.520	9.130	.012	2240.9	9.55	186.7
	24	73.0	21.47	.390	9.000	.012	2091.0	9.87	174.3
B20a	20	82.0	24.17	.570	8.890	.015	1559.8	8.03	156.0
	20	72.0	21.37	.430	8.750	.015	1466.5	8.28	146.7
B20	20	69.0	20.26	.520	8.145	.015	1268.9	7.91	126.9
	20	64.0	18.86	.450	8.075	.015	1222.1	8.05	122.2
	20	59.0	17.36	.375	8.000	.015	1172.2	8.22	117.2
B18	18	59.0	17.40	.495	7.675	.016	883.3	7.12	98.1
	18	54.0	15.87	.410	7.590	.016	842.0	7.28	93.6
	18	52.0	15.24	.375	7.555	.016	825.0	7.36	91.7
	18	48.5	14.25	.320	7.500	.016	798.3	7.48	88.7
B15b	15	71.0	20.95	.520	7.500	.020	796.2	6.16	106.2
B15a	15	64.0	18.81	.605	7.195	.020	664.9	5.95	88.6
	15	54.0	15.88	.410	7.000	.020	610.0	6.20	81.3
B15	15	46.0	13.52	.440	6.810	.020	484.8	5.99	64.6
	15	41.0	12.02	.340	6.710	.020	456.7	6.16	60.9
	15	38.0	11.27	.290	6.660	.020	442.6	6.27	59.0
B12a	12	36.0	10.61	.310	6.300	.025	269.2	5.04	44.9
B12	12	32.0	9.44	.335	6.205	.025	228.5	4.92	38.1
	12	28.5	8.42	.250	6.120	.025	216.2	5.07	36.0
B10	10	28.5	8.34	.390	5.990	.029	134.6	4.02	26.9
	10	23.5	6.94	.250	5.850	.029	122.9	4.21	24.6
B9	9	24.0	7.04	.365	5.555	.033	92.1	3.62	20.5
	9	20.0	6.01	.250	5.440	.033	85.1	3.76	18.9
B8	8	19.5	5.78	.325	5.325	.037	60.6	3.24	15.1
	8	17.5	5.18	.250	5.250	.037	57.4	3.33	14.3

W = Safe load in pounds, uniformly distributed, including weight of beam.

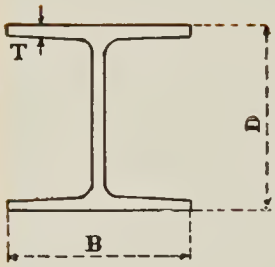
L = Span, in feet. M = Moment of forces, in foot pounds.

PROPERTIES OF BETHLEHEM I BEAMS

COEFFICIENTS OF STRENGTH				Maximum Safe Shear on Web, in Pounds	Neutral Axis Coincident with Center Line of web		Section Number
For Fiber Stress of 16,000 Lbs. per Sq. Inch for Buildings *C*	Add for each Lb. Increase in weight of Beam	For Fiber Stress of 12,500 Lbs per Sq. Inch for Moving Loads *C'*	Add for each Lb. Increase in weight of Beam		Moment of Inertia *I'*	Radius of Gyration *r'*	
3,726,000	15,690	2,910,900	12,270	103,800	165.0	2.16	**B30**
3,058,400	14,640	2,389,300	11,450	89,000	131.5	2.06	**B28**
2,442,800	13,600	1,908,500	10,630	75,300	101.2	1.96	**B26**
2,117,300	12,550	1,654,100	9,820	75,100	91.1	1.92	**B24a**
1,991,900	12,550	1,556,200	9,820	93,100	78.0	1.78	**B24**
1,858,700	12,550	1,452,100	9,820	54,000	74.4	1.86	
1,663,800	10,460	1,299,800	8,180	102,400	79.9	1.82	**B20a**
1,564,300	10,460	1,222,100	8,180	64,900	75.9	1.88	
1,353,500	10,460	1,057,400	8,180	88,200	51.2	1.59	**B20**
1,303,600	10,460	1,018,500	8,180	69,400	49.8	1.62	
1,250,300	10,460	976,800	8,180	50,000	48.3	1.66	
1,046,900	9,410	817,900	7,360	78,000	39.1	1.50	**B18**
997,900	9,410	779,600	7,360	57,500	37.7	1.54	
977,700	9,410	763,900	7,360	49,200	37.1	1.56	
946,100	9,410	739,100	7,360	36,700	36.2	1.59	
1,132,400	7,840	884,700	6,140	77,900	61.3	1.71	**B15b**
945,600	7,840	738,700	6,140	93,900	41.9	1.49	**B15a**
867,600	7,840	677,800	6,140	54,800	38.3	1.55	
689,500	7,840	538,600	6,140	60,000	25.2	1.36	**B15**
649,400	7,840	507,400	6,140	39,900	24.0	1.41	
629,500	7,840	491,800	6,140	30,100	23.4	1.44	
478,600	6,280	373,900	4,910	32,200	21.3	1.42	**B12a**
406,200	6,280	317,300	4,910	35,800	16.0	1.30	**B12**
384,400	6,280	300,300	4,910	22,200	15.3	1.35	
287,100	5,230	224,300	4,090	39,800	12.1	1.21	**B10**
262,200	5,230	204,800	4,090	21,000	11.2	1.27	
218,300	4,710	170,600	3,680	33,900	8.8	1.12	**B9**
201,800	4,710	157,600	3,680	20,100	8.2	1.17	
161,600	4,180	126,200	3,270	26,900	6.7	1.08	**B8**
153,000	4,180	119,600	3,270	18,900	6.4	1.11	

C and C' = Coefficients given in the table.

$W = \frac{C \text{ or. } C'}{L}$ $M = \frac{C \text{ or. } C'}{8}$ C or C' = W L = 8 M = $^2/_3$fS



DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

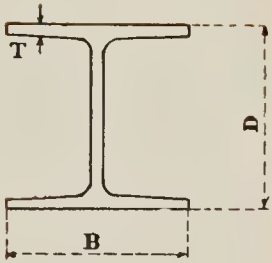
14″ H COLUMNS.

Section Number	Weight of Section, lbs. per Foot	DIMENSIONS, IN INCHES							
		D	Nominal T	B	W	M	N	G	L
H14	83.5	13 3/4	11/16	13.92	.43	.620	.755	19 5/8	L is constant = 11.06″
	91.0	13 7/8	3/4	13.96	.47	.683	.817	19 3/4	
	99.0	14	13/16	14.00	.51	.745	.880	19 13/16	
	106.5	14 1/8	7/8	14.04	.55	.808	.942	19 15/16	
	114.5	14 1/4	15/16	14.08	.59	.870	1.005	20 1/16	
	122.5	14 3/8	1	14.12	.63	.933	1.067	20 3/16	
	130.5	14 1/2	1 1/16	14.16	.67	.995	1.130	20 1/4	
	138.0	14 5/8	1 1/8	14.19	.70	1.058	1.192	20 3/8	
	146.0	14 3/4	1 3/16	14.23	.74	1.120	1.255	20 1/2	
	154.0	14 7/8	1 1/4	14.27	.78	1.183	1.317	20 5/8	
	162.0	15	1 5/16	14.31	.82	1.245	1.380	20 3/4	
	170.5	15 1/8	1 3/8	14.35	.86	1.308	1.442	20 7/8	
	178.5	15 1/4	1 7/16	14.39	.90	1.370	1.505	21	
	186.5	15 3/8	1 1/2	14.43	.94	1.433	1.567	21 1/8	
	195.0	15 1/2	1 9/16	14.47	.98	1.495	1.630	21 1/4	
	203.5	15 5/8	1 5/8	14.51	1.02	1.558	1.692	21 3/8	
	211.0	15 3/4	1 11/16	14.54	1.05	1.620	1.755	21 7/16	
	219.5	15 7/8	1 3/4	14.58	1.09	1.683	1.817	21 9/16	
	227.5	16	1 13/16	14.62	1.13	1.745	1.880	21 11/16	
	236.0	16 1/8	1 7/8	14.66	1.17	1.808	1.942	21 13/16	
	244.5	16 1/4	1 15/16	14.70	1.21	1.870	2.005	21 15/16	
	253.0	16 3/8	2	14.74	1.25	1.933	2.067	22 1/16	
	261.5	16 1/2	2 1/16	14.78	1.29	1.995	2.130	22 3/16	
	270.0	16 5/8	2 1/8	14.82	1.33	2.058	2.192	22 5/16	
	278.5	16 3/4	2 3/16	14.86	1.37	2.120	2.255	22 7/16	
	287.5	16 7/8	2 1/4	14.90	1.41	2.183	2.317	22 9/16	

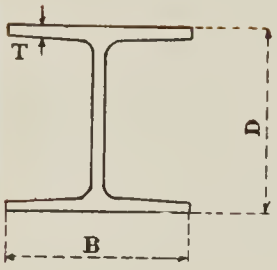
DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

14″ H COLUMNS



Weight of Section, lbs. per Foot	Area of Section, Square Inches	AXIS XX.			AXIS YY.			Section Number
		Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration, Inches *r*	Moment of Inertia *I′*	Section Modulus *S′*	Radius of Gyration, Inches *r′*	
83.5	24.46	884.9	128.7	6.01	294.5	42.3	3.47	
91.0	26.76	976.8	140.8	6.04	325.4	46.6	3.49	
99.0	29.06	1070.6	153.0	6.07	356.9	51.0	3.50	
106.5	31.38	1166.6	165.2	6.10	387.8	55.2	3.52	
114.5	33.70	1264.5	177.5	6.13	420.3	59.7	3.53	
122.5	36.04	1364.6	189.9	6.16	453.4	64.2	3.55	
130.5	38.38	1466.7	202.3	6.18	486.9	68.8	3.56	
138.0	40.59	1568.4	214.5	6.21	519.7	73.3	3.58	
146.0	42.95	1674.7	227.1	6.24	554.4	77.9	3.59	
154.0	45.33	1783.3	239.8	6.27	589.5	82.6	3.61	
162.0	47.71	1894.0	252.5	6.30	626.1	87.5	3.62	
170.5	50.11	2007.0	265.4	6.33	662.3	92.3	3.64	**H14**
178.5	52.51	2122.3	278.3	6.36	699.0	97.2	3.65	
186.5	54.92	2239.8	291.4	6.39	736.3	102.1	3.66	
195.0	57.35	2359.7	304.5	6.41	774.2	107.0	3.67	
203.5	59.78	2481.9	317.7	6.44	812.6	112.0	3.69	
211.0	62.07	2603.3	330.6	6.48	849.8	116.9	3.70	
219.5	64.52	2730.2	344.0	6.51	889.3	122.0	3.71	
227.5	66.98	2859.6	357.5	6.53	929.4	127.1	3.73	
236.0	69.45	2991.5	371.0	6.56	970.0	132.3	3.74	
244.5	71.94	3125.8	384.7	6.59	1011.3	137.6	3.75	
253.0	74.43	3262.7	398.5	6.62	1053.2	142.9	3.76	
261.5	76.93	3402.1	412.4	6.65	1095.6	148.3	3.77	
270.0	79.44	3544.1	426.4	6.68	1138.7	153.7	3.79	
278.5	81.97	3688.8	440.5	6.71	1182.4	159.1	3.80	
287.5	84.50	3836.1	454.7	6.74	1226.7	164.7	3.81	



DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

12 H″ COLUMNS.

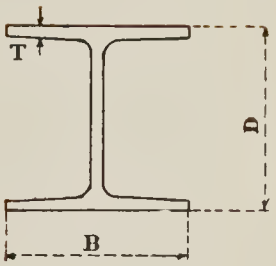
Section Number.	Weight of Section, lbs. per Foot	DIMENSIONS, IN INCHES.							
		D	Nominal *T*	*B*	*W*	*M*	*N*	*G*	*L*
	64.5	11 3/4	5/8	11.92	.39	.567	.683	16 3/4	
	71.5	11 7/8	11/16	11.96	.43	.630	.745	16 7/8	
	78.0	12	3/4	12.00	.47	.693	.808	17	
	84.5	12 1/8	13/16	12.04	.51	.755	.870	17 1/8	
	91.5	12 1/4	7/8	12.08	.55	.817	.933	17 1/4	
	98.5	12 3/8	15/16	12.12	.59	.880	.995	17 3/8	
	105.0	12 1/2	1	12.16	.63	.942	1.058	17 7/16	
H12	112.0	12 5/8	1 1/16	12.20	.67	1.005	1.120	17 9/16	
	118.5	12 3/4	1 1/8	12.23	.70	1.067	1.183	17 11/16	
	125.5	12 7/8	1 3/16	12.27	.74	1.130	1.245	17 13/16	
	132.5	13	1 1/4	12.31	.78	1.192	1.308	17 15/16	
	139.5	13 1/8	1 5/16	12.35	.82	1.255	1.370	18	
	146.5	13 1/4	1 3/8	12.39	.86	1.317	1.433	18 1/8	
	153.5	13 3/8	1 7/16	12.43	.90	1.380	1.495	18 1/4	
	161.0	13 1/2	1 1/2	12.47	.94	1.442	1.558	18 3/8	

L is constant = 9.21″

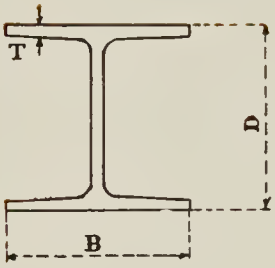
DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

12″ H COLUMNS.



Weight of Section lbs. per Foot	Area of Section, Square Inches	AXIS XX			AXIS YY			Section Number
		Moment of Inertia I	Section Modulus S	Radius of Gyration, Inches r	Moment of Inertia I′	Section Modulus S′	Radius of Gyration, Inches r′	
64.5	19.00	499.0	84.9	5.13	168.6	28.3	2.98	
71.5	20.96	556.6	93.7	5.15	188.2	31.5	3.00	
78.0	22.94	615.6	102.6	5.18	208.1	34.7	3.01	
84.5	24.92	676.1	111.5	5.21	228.5	37.9	3.03	
91.5	26.92	738.1	120.5	5.24	249.2	41.3	3.04	
98.5	28.92	801.7	129.6	5.27	270.1	44.6	3.06	
105.0	30.94	866.8	138.5	5.30	291.7	48.0	3.07	
112.0	32.96	933.4	147.9	5.33	313.6	51.4	3.08	H12
118.5	34.87	1000.0	156.9	5.36	335.0	54.8	3.10	
125.5	36.91	1069.8	166.2	5.38	357.7	58.3	3.11	
132.5	38.97	1141.3	175.6	5.41	380.7	61.9	3.13	
139.5	41.03	1214.5	185.0	5.44	404.1	65.4	3.14	
146.5	43.10	1289.4	194.6	5.47	428.0	69.1	3.15	
153.5	45.19	1366.0	204.3	5.50	452.2	72.8	3.16	
161.0	47.28	1444.3	214.0	5.53	477.0	76.5	3.18	



DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

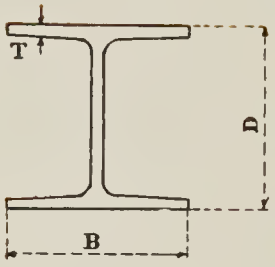
10″ H COLUMNS.

Section Number	Weight of Section, lbs. per Foot	DIMENSIONS, IN INCHES.							
		D	Nominal T	B	W	M	N	G	L
H10	49.0	9 7/8	9/16	9.97	.36	.514	.611	14 1/16	L is constant = 7.67″
	54.0	10	5/8	10.00	.39	.577	.673	14 3/16	
	59.5	10 1/8	11/16	10.04	.43	.639	.736	14 5/16	
	65.5	10 1/4	3/4	10.08	.47	.702	.798	14 9/16	
	71.0	10 3/8	13/16	10.12	.51	.764	.861	14 1/2	
	77.0	10 1/2	7/8	10.16	.55	.827	.923	14 5/8	
	82.5	10 5/8	15/16	10.20	.59	.889	.986	14 3/4	
	88.5	10 3/4	1	10.24	.63	.952	1.048	14 7/8	
	94.0	10 7/8	1 1/16	10.28	.67	1.014	1.111	15	
	99.5	11	1 1/8	10.31	.70	1.077	1.173	15 1/8	
	105.5	11 1/8	1 3/16	10.35	.74	1.139	1.236	15 3/16	
	111.5	11 1/4	1 1/4	10.39	.78	1.202	1.298	15 5/16	
	117.5	11 3/8	1 5/16	10.43	.82	1.264	1.361	15 7/16	
	123.5	11 1/2	1 3/8	10.47	.86	1.327	1.423	15 9/16	

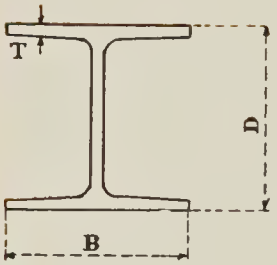
DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

10″ H COLUMNS.



Weight of Section, lbs. per Foot	Area of Section, Square Inches	AXIS XX.			AXIS YY.			Section Number
		Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration, Inches *r*	Moment of Inertia *I′*	Section Modulus *S′*	Radius of Gyration, Inches *r′*	
49.0	14.37	263.5	53.4	4.28	89.1	17.9	2.49	
54.0	15.91	296.8	59.4	4.32	100.4	20.1	2.51	
59.5	17.57	331.9	65.6	4.35	112.2	22.3	2.53	
65.5	19.23	368.0	71.8	4.37	124.2	24.6	2.54	
71.0	20.91	405.2	78.1	4.40	136.5	27.0	2.56	
77.0	22.59	443.6	84.5	4.43	149.1	29.4	2.57	
82.5	24.29	483.0	90.9	4.46	162.0	31.8	2.58	H10
88.5	25.99	523.5	97.4	4.49	175.1	34.2	2.60	
94.0	27.71	565.2	103.9	4.52	188.6	36.7	2.61	
99.5	29.32	607.0	110.4	4.55	201.7	39.1	2.62	
105.5	31.06	651.0	117.0	4.58	215.6	41.7	2.64	
111.5	32.80	696.2	123.8	4.61	229.9	44.3	2.65	
117.5	34.55	742.7	130.6	4.64	244.4	46.9	2.66	
123.5	36.32	790.4	137.5	4.67	259.3	49.5	2.67	



DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

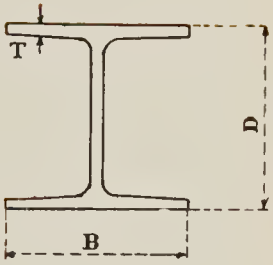
8″ H COLUMNS.

Section Number	Weight of Section, lbs. per Foot	DIMENSIONS, IN INCHES.							
		D	Nominal T	B	W	M	N	G	L
HS	31.5	7 7/8	7/16	8.00	.31	.339	.476	11 1/4	L is constant = 6.14″
	34.5	8	1/2	8.00	.31	.462	.538	11 3/8	
	39.0	8 1/8	9/16	8.04	.35	.524	.601	11 7/16	
	43.5	8 1/4	5/8	8.08	.39	.587	.663	11 9/16	
	48.0	8 3/8	11/16	8.12	.43	.649	.726	11 11/16	
	53.0	8 1/2	3/4	8.16	.47	.712	.788	11 13/16	
	57.5	8 5/8	13/16	8.20	.51	.774	.851	12	
	62.0	8 3/4	7/8	8.24	.55	.837	.913	12 1/16	
	67.0	8 7/8	15/16	8.28	.59	.899	.976	12 1/8	
	71.5	9	1	8.32	.63	.962	1.038	12 1/4	
	76.5	9 1/8	1 1/16	8.36	.67	1.024	1.101	12 3/8	
	81.0	9 1/4	1 1/8	8.39	.70	1.087	1.163	12 1/2	
	85.5	9 3/8	1 3/16	8.43	.74	1.149	1.226	12 5/8	
	90.5	9 1/2	1 1/4	8.47	.78	1.212	1.288	12 3/4	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

8″ H COLUMNS.



Weight of Section lbs. per Foot	Area of Section, Square Inches	AXIS XX.			AXIS YY.			Section Number
		Moment of Inertia *I*	Section Modulus *S*	Radius of Gyration, Inches *r*	Moment of Inertia *I′*	Section Modulus *S′*	Radius of Gyration, Inches *r′*	
31.5	9.17	105.7	26.9	3.40	35.8	8.9	1.98	
34.5	10.17	121.5	30.4	3.46	41.1	10.3	2.01	
39.0	11.50	139.5	34.3	3.48	47.2	11.7	2.03	
43.5	12.83	158.3	38.4	3.51	53.4	13.2	2.04	
48.0	14.18	177.7	42.4	3.54	59.8	14.7	2.05	
53.0	15.53	197.8	46.5	3.57	66.3	16.3	2.07	
57.5	16.90	218.6	50.7	3.60	73.1	17.8	2.08	HS
62.0	18.27	240.2	54.9	3.63	80.0	19.4	2.09	
67.0	19.66	262.5	59.2	3 65	87.1	21.0	2.11	
71.5	21.05	285.6	63.5	3.68	94.4	22.7	2.12	
76.5	22.46	309.5	67.8	3.71	101.9	24.4	2.13	
81.0	23.78	333.5	72.1	3.75	109.2	26.0	2.14	
85.5	25.20	359.0	76.6	3.77	117.2	27.8	2.16	
90.5	26.64	385.3	81.1	3.80	125.1	29.6	2.17	

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS,

IN TONS OF 2,000 LBS.
Beams Being Secured Against Yielding Sideways.

Span in Feet	39″G		Add for each lb. inc. in Wgt.	28″G		Add for each lb. inc. in. Wgt.	26″G		Add for each lb. inc. in Wgt.
	G30a	G30		G28a	G28		G26a	G26	
	200 lbs.	180 lbs.		180 lbs.	165 lbs.		160 lbs.	150 lbs.	
18	180.75	161.87	.44	153.75	138.89	.41	128.11	117.47	.38
19	171.24	153.35	.41	145.66	131.58	.39	121.37	111.29	.36
20	162.68	145.68	.39	138.38	125.00	.37	115.30	105.72	.34
21	154.93	138.74	.37	131.79	119.05	.35	109.81	100.69	.32
22	147.89	132.44	.36	125.80	113.64	.33	104.82	96.11	.31
23	141.46	126.68	.34	120.33	108.70	.32	100.26	91.93	.30
24	135.56	121.40	.33	115.31	104.17	.31	96.08	88.10	.28
25	130.14	116.55	.31	110.70	100.00	.29	92.24	84.58	.27
26	125.14	112.06	.30	106.44	96.16	.28	88.69	81.32	.26
27	120.50	107.91	.29	102.50	92.60	.27	85.41	78.31	.25
28	116.20	104.06	.28	98.84	89.29	.26	82.36	75.52	.24
29	112.19	100.47	.27	95.43	86.21	.25	79.52	72.91	.23
30	108.45	97.12	.26	92.25	83.34	.24	76.87	70.48	.23
31	104.95	93.99	.25	89.27	80.65	.24	74.39	68.21	.22
32	101.67	91.05	.25	86.48	78.13	.23	72.06	66.08	.21
33	98.59	88.29	.24	83.86	75.76	.22	69.88	64.07	.21
34	95.69	85.70	.23	81.40	73.53	.22	67.82	62.19	.20
35	92.96	83.25	.22	79.07	71.43	.21	65.88	60.41	.19
36	90.38	80.93	.22	76.88	69.45	.20	64.05	58.73	.19
37	87.93	78.75	.21	74.80	67.57	.20	62.32	57.15	.18
38	85.62	76.67	.21	72.83	65.79	.19	60.68	55.64	.18
39	83.42	74.71	.20	70.96	64.10	.19	59.13	54.22	.17
40	81.34	72.84	.20	69.19	62.50	.18	57.65	52.86	.17
41	79.35	71.06	.19	67.50	60.98	.18	56.24	51.57	.17
42	77.47	69.37	.19	65.89	59.53	.17	54.90	50.34	.16
43	75.66	67.76	.18	64.36	58.14	.17	53.63	49.17	.16
44	73.94	66.22	.18	62.90	56.82	.17	52.41	48.06	.15
45	72.30	64.75	.17	61.50	55.56	.16	51.24	46.99	.15
46	70.73	63.34	.17	60.16	54.35	.16	50.13	45.97	.15
47	69.22	61.99	.17	58.88	53.19	.16	49.06	44.99	.14
48	67.78	60.70	.16	57.66	52.09	.15	48.04	44.05	.14

Safe loads given include weight of beam.
Maximum fiber stress, 16,000 lbs. per square inch.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS,

IN TONS OF 2,000 Lbs.

Beams Being Secured Against Yielding Sideways.

Span in Feet	24″G		Add for each lb. Incr in Wgt.	20″G		Add for each lb. Incr. in Wgt.	18″G	Add for each lb. Incr. in Wgt.
	G24a	G24		G20a	G20		G18	
	140 lbs.	120 lbs.		140 lbs.	112 lbs		92 lbs.	
12	155.61	133.60	.52	130.43	104.09	.44	78.59	.39
13	143.64	123.33	.48	120.40	96.09	.40	72.54	.36
14	133.38	114.52	.45	111.80	89.23	.37	67.36	.34
15	124.48	106.88	.42	104.34	83.28	.35	62.87	.31
16	116.71	100.20	.39	97.82	78.07	.33	58.94	.29
17	109.84	94.31	.37	92.07	73.48	.31	55.47	.28
18	103.74	89.07	.35	86.95	69.40	.29	52.39	.26
19	98.28	84.38	.33	82.38	65.74	.28	49.63	.25
20	93.37	80.16	.31	78.26	62.46	.26	47.15	.24
21	88.92	76.35	.30	74.53	59.48	.25	44.91	.22
22	84.88	72.88	.29	71.14	56.78	.24	42.87	.21
23	81.19	69.71	.27	68.05	54.31	.23	41.00	.20
24	77.80	66.80	.26	65.22	52.05	.22	39.29	.20
25	74.69	64.15	.25	62.61	49.97	.21	37.72	.19
26	71.82	61.66	.24	60.20	48.04	.20	36.27	.18
27	69.16	59.38	.23	57.97	46.26	.19	34.93	.17
28	66.69	57.26	.22	55.90	44.61	.19	33.68	.17
29	64.39	55.29	.22	53.97	43.07	.18	32.52	.16
30	62.24	53.44	.21	52.17	41.64	.17	31.43	.16
31	60.24	51.72	.20	50.49	40.30	.17	30.42	.15
32	58.35	50.10	.20	48.91	39.04	.16	29.47	.15
33	56.58	48.58	.19	47.43	37.85	.16	28.58	.14
34	54.92	47.15	.18	46.04	36.74	.15	27.74	.14
35	53.35	45.81	.18	44.72	35.69	.15	26.94	.13
36	51.87	44.54	.17	43.48	34.70	.15	26.20	.13
37	50.47	43.33	.17	42.30	33.76	.14	25.49	.13
38	49.14	42.19	.17	41.19	32.87	.14	24.82	.12
39	47.88	41.11	.16	40.13	32.03	.13	24.18	.12
40	46.68	40.08	.16	39.13	31.23	.13	23.58	.12

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted line produce deflections exceeding 1-360 of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS,

IN TONS OF 2,000 LBS.

Beams Being Secured Against Yielding Sideways.

Span, in Feet	15″G			Add for each lb. Inc. in Wgt.	12″G		Add for each lb. Inc. in Wgt.
	G15b	G15a	G15		G12a	G12	
	140 lbs.	104 lbs.	73 lbs.		70 lbs.	55 lbs.	
10	113.26	86.76	62.83	.39	47.89	38.40	.31
11	102.96	78.88	57.12	.36	43.54	34.91	.29
12	94.38	72.30	52.36	.33	39.91	32.00	.26
13	87.12	66.74	48.33	.30	36.84	29.54	.24
14	80 90	61.97	44.88	.28	34.21	27.43	.22
15	75.51	57.84	41.89	.26	31.93	25.60	.21
16	70.79	54.23	39.27	.25	29.93	24.00	.20
17	66.62	51.04	36.96	.23	28.17	22.59	.19
18	62 92	48.20	34.91	.22	26.61	21.33	.18
19	59.61	45.67	33.07	.21	25.21	20.21	.17
20	56.63	43.38	31.42	.20	23.95	19.20	.16
21	53.93	41.32	29.92	.19	22.81	18.28	.15
22	51.48	39.44	28.56	.18	21.77	17.45	.14
23	49.24	37.72	27.32	.17	20.82	16.69	.14
24	47.19	36.15	26.18	.16	19.95	16.00	.13
25	45.30	34.71	25.13	.16	19.16	15.36	.13
26	43.56	33.37	24.17	.15	18.42	14.77	.12
27	41.95	32.13	23.27	.15	17.74	14.22	.12
28	40.45	30.99	22.44	.14	17.10	13.71	.11
29	39.05	29.92	21.67	.14	16.51	13.24	.11
30	37.75	28.92	20.94	.13	15.96	12.80	.10
31	36.54	27.99	20.27	.13	15.45	12.39	.10
32	35.39	27.11	19.63	.12	14.97	12.00	.10
33	34.32	26.29	19.04	.12	14.51	11.64	.10
34	33.31	25.52	18.48	.12	14.09	11.29	.09
35	32.36	24.79	17.95	.11	13.68	10.97	.09

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Load given above the heavy line is greater than safe load for web crippling.

Safe loads given below the dotted lines produce deflections exceeding 1-360 of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS,

IN TONS OF 2,000 LBS.

Beams Being Secured Against Yielding Sideways.

Span, in Feet	10″G G10 44 lbs.	Add for each lb. Increase in Weight	Span, in Feet	9″G G9 38 lbs.	Add for each lb. Increase in Weight	8″G G8 32.5 lbs.	Add for each lb. Increase in Weight
10	26.05	.26	**5**	40.50	.47	30.51	.42
11	23.68	.24	**6**	33.75	.39	25.42	.35
12	21.71	.22	**7**	28.93	.34	21.79	.30
13	20.04	.20	**8**	25.31	.29	19.07	.26
14	18.61	.19	**9**	22.50	.26	16.95	.23
15	17.37	.17	**10**	20.25	.23	15.25	.21
16	16.28	.16	**11**	18.41	.21	13.87	.19
17	15.32	.15	**12**	16.88	.20	12.71	.17
18	14.47	.15	**13**	15.58	.18	11.73	.16
19	13.71	.14	**14**	14.47	.17	10.90	.15
20	13.03	.13	**15**	13.50	.16	10.17	.14
21	12.40	.12	**16**	12.66	.15	9.53	.13
22	11.84	.12	**17**	11.91	.14	8.97	.12
23	11.33	.11	**18**	11.25	.13	8.47	.12
24	10.85	.11	**19**	10.66	.12	8.03	.11
25	10.42	.10	**20**	10.13	.12	7.63	.10
26	10.02	.10	**21**	9.64	.11	7.26	.10
27	9.65	.10	**22**	9.21	.11	6.93	.09
28	9.30	.09	**23**	8.80	.10	6.63	.09
29	8.98	.09	**24**	8.84	.10	6.36	.08
30	8.68	.09	**25**	8.10	.09	6.10	.08
31	8.40	.08	**26**	7.79	.09	.....	.....
32	8.14	.08	**27**	7.50	.09	.....	.....
33	7.89	.08	**28**	7.23	.08	.....	.....
34	7.66	.08	**29**	6.98	.08	.....	.....
35	7.44	.07	**30**	6.75	.0	.....	.....

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted lines produce deflections exceeding 1-360 of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM I BEAMS

IN TONS OF 2,000 LBS.
Beams being secured against yielding sideways.

Span, in Feet	30″I B30 120 lbs.	Add for each lb. Incr. in Weight	28″I B28 105 lbs.	Add for each lb. Incr. in Weight	26″I B26 90 lbs.	Add for each lb. Incr. in Weight	Span, in Feet	24I B24a 84 lbs.	24I B24 73 lbs.	Add for each lb. Incr. in Weight
18	103.50	.44	84.95	.41	67.86	.38	**12**	88.22	77.45	.52
19	98.05	.41	80.48	.39	64.29	.36	**13**	81.43	71.49	.48
20	93.15	.39	76.46	.37	61.07	.34	**14**	75.62	66.38	.45
21	88.71	.37	72.82	.35	58.16	.32	**15**	70.58	61.96	.42
22	84.68	.36	69.51	.33	55.52	.31	**16**	66.16	58.08	.39
23	81.00	.34	66.49	.32	53.11	.30	**17**	62.27	54.67	.37
24	77.62	.33	63.72	.31	50.89	.28	**18**	58.81	51.63	.35
25	74.52	.31	61.17	.29	48.86	.27	**19**	57.72	48.91	.33
26	71.65	.30	58.81	.18	46.98	.26	**20**	52.93	46.47	.31
27	69.00	.29	56.64	.27	45.24	.25	**21**	50.41	44.26	.30
28	66.54	.28	54.61	.26	43.62	.24	**22**	48.12	42.24	.29
29	64.24	.27	52.73	.25	42.12	.23	**23**	46.03	40.41	.27
30	62.10	.26	50.97	.24	40.71	.23	**24**	44.11	38.72	.26
31	60.10	.25	49.33	.24	39.40	.22	**25**	42.35	37.17	.25
32	58.22	.25	47.79	.23	38.17	.21	**26**	40.72	35.74	.24
33	56.45	.24	46.34	.22	37.01	.21	**27**	39.21	34.42	.23
34	54.79	.23	44.98	.22	35.92	.20	**28**	37.81	33.19	.22
35	53.23	.22	43.69	.21	34.90	.19	**29**	36.50	32.05	.22
36	51.75	.22	42.48	.20	33.93	.19	**30**	35.29	30.98	.21
37	50.35	.21	41.33	.20	33.01	.18	**31**	34.15	29.98	.20
38	49.03	.21	40.24	.19	32.14	.18	**32**	33.08	29.04	.20
39	47.77	.20	39.21	.19	31.32	.17	**33**	32.08	28.16	.19
40	46.57	.20	38.23	.19	30.54	.17	**34**	31.14	27.33	.19
41	45.44	.19	37.30	.18	29.79	.17	**35**	30.25	26.55	.18
42	44.36	.19	36.41	.18	29.08	.16	**36**	29.41	25.82	.17
43	43.33	.18	35.56	.17	28.41	.16	**37**	28.61	25.12	.17
44	42.34	.18	34.75	.17	27.76	.15	**38**	27.86	24.46	.17
45	41.40	.17	33.98	.16	27.14	.15	**39**	27.14	23.83	.16
46	40.50	.17	33.24	.16	26.55	.15	**40**	26.47	23.23	.16
47	39.64	.17	32.54	.16	25.99	.14				
48	38.81	.16	31.86	.15	25.45	.14				

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM I BEAMS

IN TONS OF 2,000 LBS.
Beams being secured against yielding sideways.

Span, in Feet	20″I					Add for each lb. Incr. in Wgt.	18″I			Add for each lb. Incr. in Wgt.
	B20a		B20				B18			
	82 lbs.	72 lbs.	69 lbs.	64 lbs.	59 lbs.		59 lbs.	54 lbs.	48.5 lbs.	
12	69.33	65.18	56.40	54.32	52.10	.44	43.62	41.58	39.42	.39
13	63.99	60.17	52.06	50.14	48.09	.40	40.26	38.38	36.39	.36
14	59.42	55.87	48.34	46.56	44.65	.37	37.39	35.64	33.79	.34
15	55.46	52.14	45.12	43.45	41.68	.35	34.90	33.26	31.54	.31
16	51.99	48.88	42.30	40.74	39.07	.33	32.71	31.18	29.56	.29
17	48.94	46.01	39.81	38.34	36.77	.31	30.79	29.35	27.83	.28
18	46.22	43.45	37.60	36.21	34.73	.29	29.08	27.72	26.28	.26
19	43.78	41.17	35.62	34.31	32.90	.28	27.55	26.26	24.99	.25
20	41.60	39.11	33.84	32.59	31.26	.26	26.17	24.95	23.65	.24
21	39.61	37.25	32.23	31.04	29.77	.25	24.93	23.76	22.53	.22
22	37.81	35.55	30.76	29.63	28.42	.24	23.79	22.68	21.50	.21
23	36.17	34.01	29.42	28.34	27.18	.23	22.76	21.70	20.57	.21
24	34.66	32.59	28.20	27.16	26.05	.22	21.81	20.79	19.71	.20
25	33.28	31.29	27.07	26.07	25.01	.21	20.94	19.96	18.92	.19
26	32.00	30.08	26.03	25.07	24.04	.20	20.13	19.19	18.19	.18
27	30.81	28.97	25.07	24.14	23.15	.19	19.39	18.48	17.52	.17
28	29.71	27.93	24.17	23.28	22.33	.19	18.69	17.82	16.89	.17
29	28.69	26.97	23.34	22.48	21.56	.18	18.05	17.21	16.31	.16
30	27.73	26.07	22.56	21.73	20.84	.17	17.45	16.63	15.77	.16
31	26.84	25.23	21.83	21.03	20.17	.17	16.88	16.10	15.26	.15
32	26.00	24.44	21.15	20.37	19.54	.16	16.36	15.59	14.78	.15
33	25.21	23.70	20.51	19.75	18.94	.16	15.86	15.12	14.33	.14
34	24.47	23.00	19.90	19.17	18.39	.15	15.40	14.68	13.91	.14
35	23.77	22.35	19.34	18.62	17.86	.15	14.96	14.26	13.52	.13
36	23.11	21.73	18.80	18.11	17.37	.15	14.54	13.86	13.14	.13
37	22.48	21.14	18.29	17.62	16.90	.14	14.15	13.49	12.78	.13
38	21.89	20.58	17.81	17.15	16.45	.14	13.77	13.13	12.45	.12
39	21.33	20.06	17.35	16.71	16.03	.13	13.42	12.79	12.13	.12
40	20.80	19.55	16.92	16.30	15.63	.13	13.09	12.47	11.83	.12

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.
Load given above the heavy line exceeds safe load for web crippling.
Safe loads below the dotted lines produce deflections exceeding 1-360 of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM I BEAMS

IN TONS OF 2,000 LBS.
Beams being secured against yielding sideways.

Span, in Feet	15″I					Add for each lb. Incr. in Wgt.	Span, in Feet	12″I		
	B15b	B15a	B15					B12a	B12	
	71 lbs.	54 lbs.	46 lbs.	41 lbs.	38 lbs.			36 lbs.	32 lbs.	28.5 lbs.
12	47.18	36.15	28.73	27.06	26.23	.33	**9**	26.59	22.57	21.36
13	43.55	33.37	26.52	24.98	24.21	.30	**10**	23.93	20.31	19.22
14	40.44	30.99	24.62	23.19	22.48	.28				
15	37.75	28.92	22.98	21.65	20.98	.25	**11**	21.76	18.46	17.47
							12	19.94	16.92	16.02
16	35.39	27.11	21.55	20.30	19.67	.26	**13**	18.41	15.62	14.79
17	33.30	25.52	20.28	19.10	18.51	.23	**14**	17.09	14.51	13.73
18	31.45	24.10	19.15	18.04	17.49	.22	**15**	15.95	13.54	12.81
19	29.80	22.83	18.14	17.09	16.56	.21				
20	28.31	21.69	17.24	16.24	15.74	.20	**16**	14.96	12.69	12.01
							17	14.08	11.95	11.31
21	26.96	20.66	16.42	15.46	14.99	.19	**18**	13.30	11.28	10.68
22	25.74	19.72	15.67	14.76	14.31	.18	**19**	12.60	10.69	10.12
23	24.62	18.86	14.99	14.12	13.68	.17	**20**	11.97	10.15	9.61
24	23.59	18.07	14.36	13.53	13.11	.16				
25	22.65	17.35	13.79	12.99	12.59	.16	**21**	11.40	9.67	9.15
							22	10.88	9.23	8.74
26	21.78	16.68	13.26	12.49	12.11	.15	**23**	10.41	8.83	8.36
27	20.97	16.07	12.77	12.03	11.66	.15	**24**	9.97	8.46	8.01
28	20.22	15.49	12.31	11.60	11.24	.14	**25**	9.57	8.12	7.69
29	19.52	14.96	11.89	11.20	10.85	.14				
30	18.87	14.46	11.49	10.82	10.49	.13	**26**	9.20	7.81	7.39
							27	8.86	7.52	7.12
31	18.26	13.99	11.12	10.47	10.15	.13	**28**	8.55	7.25	6.86
32	17.69	13.56	10.77	10.15	9.84	.12	**29**	8.25	7.00	6.63
33	17.16	13.15	10.45	9.84	9.54	.12	**30**	9.98	6.77	6.41
34	16.65	12.76	10.14	9.55	9.26	.12				
35	16.18	12.39	9.85	9.28	8.99	.11	**31**	7.72	6.55	6.20
							32	7.48	6.35	6.01
36	15.73	12.05	9.58	9.02	8.74	.11	**33**	7.25	6.15	5.82
37	15.30	11.72	9.32	8.78	8.51	.11	**34**	7.04	5.97	5.65
38	14.90	11.42	9.07	8.55	8.28	.10	**35**	6.84	5.80	5.49
39	14.52	11.12	8.84	8.33	8.07	.10	.....	.....	.....	.....
40	14.15	10.84	8.62	8.12	7.87	.10	.....	.....	.....	.....

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Safe loads below the dotted lines produce deflections exceeding 1-360 of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM I BEAMS,

IN TONS OF 2,000 LBS.
Beams being secured against yielding sideways.

Span, in Feet	10″I B10		Add for each lb. Incr. in Wgt.	Span, in Feet	9″I B9		Add for each lb. Incr. in Wgt.	8″I B8		Add for each lb. Incr. in Wgt.
	28.5 lbs.	23.5 lbs.			24 lbs.	20 lbs.		19.5 lbs.	17.5 lbs	
9	15.95	14.57	.29	5	21.83	20.18	.47	16.16	15.30	.42
10	14.35	13.11	.26	.....	.....	.....	.....	.....	.....	.....
11	13.05	11.92	.24	6	18.19	16.81	.39	13.46	12.75	.35
12	11.96	10.92	.22	7	15.60	14.41	.34	11.54	10.93	.30
13	11.04	10.08	.20	8	13.65	12.61	.29	10.10	9.57	.26
14	10.25	9.36	.19	9	12.13	11.21	.26	8.98	8.50	.23
15	9.57	8.74	.17	10	10.92	10.09	.24	8.08	7.65	.21
16	8.97	8.19	.16	11	9.92	9.17	.21	7.34	6.96	.19
17	8.44	7.71	.15	12	9.10	8.41	.20	6.73	6.38	.17
18	7.97	7.28	.15	13	8.40	7.76	.18	6.21	5.89	.16
19	7.55	6.90	.14	14	7.80	7.21	.17	5.77	5.47	.15
20	7.18	6.55	.13	15	7.28	6.73	.16	5.39	5.10	.14
21	6.84	6.24	.12	16	6.82	6.31	.15	5.05	4.78	.13
22	6.52	5.96	.12	17	6.42	5.93	.14	4.75	4 50	.12
23	6.24	5.70	.11	18	6.07	5.61	.13	4.49	4.25	.12
24	5.98	5.46	.11	19	5.75	5.31	.13	4.25	4.03	.11
25	5.74	5.24	.10	20	5.46	5.04	.12	4.04	3.83	.11
26	5.52	5.04	.10	21	5.20	4.80	.11	3.85	3.64	.10
27	5.32	4.86	.10	22	4.96	4.59	.11	3.67	3.48	.10
28	5.13	4.68	.09	23	4.75	4.39	.10	3.51	3.33	.09
29	4.95	4.52	.09	24	4.55	4.20	.10	3.37	3.19	.09
30	4.78	4.37	.09	25	4.37	4.04	.10	3.23	3.06	.08
31	.....	.....	.....	26	4.20	3.88	.09	.....	.....	.....
32	.....	.....	.....	27	4.04	3.74	.09	.....	.....	.....
33	.....	.....	.....	28	3.90	3.60	.09	.....	.....	.....
34	.....	.....	.....	29	3.76	3.48	.08	.....	.....	.....
35	.....	.....	.....	30	3.64	3.36	.08	.....	.....	.....

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Safe loads below the dotted lines produce deflections exceeding 1-360 of the span.

SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM GIRDER BEAMS

USED AS COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000 - 55 \frac{l}{r}$ for lengths over 55 radii.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	Area of Section, Sq. In.	Least Radius of Gyration, Inches.	Unsupported Length of Columns, in Feet.					
					8 Ft.	**9** Ft.	**10** Ft.	**11** Ft.	**12** Ft.	**13** Ft.
G30a	**30**	200.0	58.71	3.28	381.6	381.6	381.6	381.6	381.6	381.6
G30	**30**	180.0	53.00	2.86	344.5	344.5	344.5	344.5	344.5	344.5
G28a	**28**	180.0	52.86	3.18	343.6	343.6	343.6	343.6	343.6	343.6
G28	**28**	165.0	48.47	2.77	315.1	315.1	315.1	315.1	315.1	312.7
G26a	**26**	160.0	46.91	3.05	304.9	304.9	304.9	304.9	304.9	304.9
G26	**26**	150.0	43.94	2.68	285.6	285.6	285.6	285.6	285.6	281.2
G24a	**24**	140.0	41.16	2.90	267.5	267.5	267.5	267.5	267.5	267.5
G24	**24**	120.0	35.38	2.66	230.0	230.0	230.0	230.0	230.0	225.8
G20a	**20**	140.0	41.19	2.91	267.8	267.8	267.8	267.8	267.8	267.8
G20	**20**	112.0	32.81	2.70	213.3	213.3	213.3	213.3	213.3	210.4
G18	**18**	92.0	27.12	2.59	176.3	176.3	176.3	176.3	175.5	172.0
G15b	**15**	140.0	41.27	2.83	268.2	268.2	268.2	268.2	268.2	267.6
G15a	**15**	104.0	30.50	2.64	198.3	198.3	198.3	198.3	198.3	194.4
G15	**15**	73.0	21.49	2.39	139.7	139.7	139.7	139.3	136.3	133.4
G12a	**12**	70.0	20.58	2.36	133.8	133.8	133.8	133.0	130.1	127.3
G12	**12**	55.0	16.18	2.24	105.2	105.2	105.2	103.2	100.9	98.5
G10	**10**	44.0	12.95	2.10	84.1	84.1	83.2	81.2	79.2	77.1
G9	**9**	38.0	11.22	1.98	72.9	72.9	71.1	69.2	67.3	65.4
G8	**8**	32.5	9.54	1.86	62.0	61.1	59.4	57.7	56.0	54.3

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM GIRDER BEAMS

USED AS COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

16,000 —55 $\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS, IN FEET.										Section Number.
14 Ft.	**15** Ft.	**16** Ft.	**18** Ft.	**20** Ft.	**22** Ft.	**24** Ft.	**28** Ft.	**32** Ft.	**36** Ft.	
381.6	381.6	375.2	363.4	351.5	339.7	327.9	304.3	280.7	257.0	**G30a**
338.4	332.3	326.2	313.9	301.7	289.5	277.2	252.8	228.3	203.9	**G30**
343.6	340.6	335.1	324.1	313.1	302.2	291.2	269.3	247.3	225.4	**G28a**
306.9	301.1	295.4	283.8	272.3	260.7	249.2	226.1	203.0	179.9	**G28**
304.2	299.2	294.1	283.9	273.8	263.6	253.5	233.2	212.9	192.6	**G26a**
275.8	270.4	265.0	254.1	243.3	232.5	221.7	200.0	178.4	156.8	**G26**
263.7	259.0	254.3	245.0	235.6	226.2	216.9	198.1	179.4	160.7	**G24a**
221.4	217.0	212.6	203.8	194.9	186.1	177.3	159.7	142.1	124.4	**G24**
264.1	259.5	254.8	245.5	236.1	226.8	217.4	198.8	180.1	161.4	**G20a**
206.4	202.3	198.3	190.3	182.3	174.3	166.2	150.2	134.2	.....	**G20**
168.6	165.1	161.7	154.8	147.9	140.9	134.0	120.2	106.4	.....	**G18**
262.8	258.0	253.2	243.5	233.9	224.3	214.7	195.4	176.2	.....	**G15b**
190.6	186.8	183.0	175.4	167.8	160.1	152.5	137.3	122.0	.....	**G15a**
130.4	127.4	124.5	118.5	112.6	106.7	100.7	88.9	.....	.....	**G15**
124.4	121.5	118.6	112.9	107.1	101.4	95.6	84.1	.....	.....	**G12a**
96.1	93.7	91.3	86.6	81.8	77.0	72.3	62.7	.....	.....	**G12**
75.1	73.1	71.0	67.0	62.9	58.8	54.7	.....	.....	.....	**G10**
63.6	61.7	59.8	56.1	52.4	48.6	44.9	.....	.....	.....	**G9**
52.7	51.0	43.9	45.9	42.5	39.1	35.7	.....	.....	.....	**G8**

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM I BEAMS

USED AS COLUMNS.
SQUARE ENDS.

Section Number.	Depth of Beam Inches.	Weight per Foot, Pounds.	Area of Section Sq. In.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS					
					5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.
B30	30	120.0	35.30	2.16	229.5	229.5	229.5	229.5	229.5	228.5
B28	28	105.0	30.88	2.06	200.7	200.7	200.7	200.7	200.7	197.6
B26	26	90.0	26.49	1.95	172.2	172.2	172.2	172.2	171.6	167.1
B24a	24	84.0	24.80	1.92	161.2	161.2	161.2	161.2	160.0	155.8
B24	24	83.0	24.59	1.78	159.9	159.9	159.9	159.9	155.7	151.2
	24	73.0	21.47	1.86	139.6	139.6	139.6	139.6	137.5	133.7
B20a	20	82.0	24.17	1.82	157.1	157.1	157.1	157.1	153.9	149.5
	20	72.0	21.37	1.88	138.9	138.9	138.9	138.9	137.2	133.5
	20	69.0	20.26	1.59	131.7	131.7	131.7	128.4	124.2	120.0
B20	20	64.0	18.86	1.62	122.6	122.6	122.6	120.1	116.3	112.5
	20	59.0	17.36	1.66	112.8	112.8	112.8	111.3	107.8	104.4
	18	59.0	17.40	1.50	113.1	112.4	112.4	108.6	104.8	100.9
B18	18	54.0	15.87	1.54	103.2	103.2	103.2	99.8	96.4	93.0
	18	52.0	15.24	1.56	99.1	99.1	99.1	96.2	92.9	89.7
	18	48.5	14.25	1.59	92.7	92.7	92.7	90.4	87.4	84.5
B15b	15	71.0	20.95	1.71	136.2	136.2	136.2	135.3	131.2	127 ?
B15a	15	64.0	18.81	1.49	122.3	122.3	121.3	117.1	113.0	108.5
	15	54.0	15.88	1.55	103.2	103.2	103.2	100.0	96.6	93.5
	15	46.0	13.52	1.36	87.9	87.9	85.2	81.9	78.6	75.3
B15	15	41.0	12.02	1.41	78.1	78.1	76.5	73.6	70.8	68.0
	15	38.0	11.27	1.44	73.2	73.2	72.1	69.5	66.9	64.3
B12a	12	36.0	10.61	1.42	69.0	69.0	67.6	65.2	62.7	60.2
B12	12	32.0	9.44	1.30	61.4	61.2	58.8	56.4	54.0	51.6
	12	28.5	8.42	1.35	54.8	54.8	53.0	50.9	48.9	46.8
B10	10	28.5	8.34	1.21	54.2	53.0	50.8	48.5	46.2	44.0
	10	23.5	6.94	1.27	45.1	44.7	42.9	41.1	39.3	37.5
B9	9	24.0	7.04	1.20	45.8	44.7	42.8	40.9	38.9	37.0
	9	20.0	6.01	1.17	39.1	37.9	36.2	34.5	32.8	31.1
B8	8	18.5	5.78	1.08	37.4	35.6	33.9	32.1	30.3	28.6
	8	17.5	5.18	1.11	33.6	32.2	30.6	29.1	27.6	26.0

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

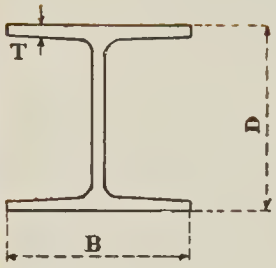
SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM I BEAMS

USED AS COLUMNS
SQUARE ENDS.

UNSUPPORTED LENGTH OF COLUMNS.										Section Number
11 Ft.	**12** Ft.	**13** Ft.	**14** Ft.	**15** Ft.	**16** Ft.	**18** Ft.	**20** Ft.	**22** Ft.	**24** Ft.	
223.1	217.7	212.3	206.9	201.5	196.1	185.3	174.6	163.8	153.0	**B30**
192.6	187.7	182.7	177.8	172.9	167.9	158.0	148.1	138.2	128.3	**B28**
162.6	158.1	153.6	149.1	144.7	140.2	131.2	122.3	113.3	104.3	**B26**
151.5	147.2	143.0	138.7	134.4	130.2	121.7	113.1	104.6	96.1	**B24a**
146.6	142.0	137.5	132.9	128.4	123.8	114.7	105.6	96.4	.....	**B24**
129.9	126.1	122.3	118.5	114.6	110.8	103.2	95.6	88.0	.....	
145.2	140.8	136.4	132.0	127.6	123.2	114.5	105.7	97.0	.....	**B20a**
129.7	126.0	122.2	118.5	114.7	111.0	103.4	95.9	88.4	.....	
115.8	111.6	107.4	103.2	99.0	94.8	86.4	78.0	.....	.....	
108.6	104.8	100.9	97.1	93.3	89.4	81.7	74.0	.....	.....	**B20**
100.9	97.5	94.0	90.6	87.1	83.7	76.8	69.9	.....	.....	
97.1	93.3	89.5	85.6	81.8	78.0	70.3	62.7	.....	.....	
89.6	86.2	82.8	79.4	76.0	72.6	65.8	59.0	.....	.....	
86.5	83.3	80.0	76.8	73.6	70.4	63.9	57.5	.....	.....	**B18**
81.5	78.5	75.6	72.6	69.7	66.7	60.8	54.9	.....	.....	
123.1	119.1	115.0	111.0	107.0	102.9	94.8	86.7	.....	.....	**B15b**
104.6	100.5	96.3	92.1	88.0	83.8	75.5	67.2	.....	.....	**B15a**
89.9	86.5	83.1	79.7	76.3	73.0	66.2	59.4	.....	.....	
72.1	68.8	65.5	62.2	58.9	55.7	49.1	.....	.....	.....	
65.2	62.4	59.6	56.8	54.0	51.1	45.5	.....	.....	.....	**B15**
61.7	59.2	56.6	54.0	51.4	48.8	43.7	.....	.....	.....	
57.8	55.3	52.8	50.4	47.9	45.4	40.5	.....	.....	.....	**B12a**
49.2	46.8	44.4	42.0	39.6	37.2	.....	.....	.....	.....	**B12**
44.7	42.7	40.6	38.6	36.5	34.4	.....	.....	.....	.....	
41.7	39.4	37.1	34.9	32.6	30.3	.....	.....	.....	.....	**B10**
35.7	33.9	32.1	30.3	28.5	26.6	.....	.....	.....	.....	
35.0	33.1	31.2	29.2	27.3	Allowable Stress per square inch:					**B9**
29.4	27.7	26.0	24.3	22.7	13,000 lbs. for lengths under 55 radii,					
26.8	25.0	23.3	21.5	19.7	16,000-55 $\frac{l}{r}$ for lengths over 55 radii.					**B8**
24.5	22.9	21.4	19.9	18.3						

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.



SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

14" H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

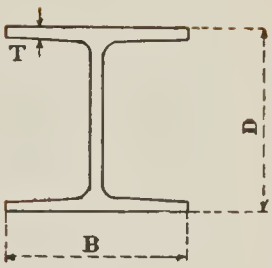
$16{,}000 - 55\frac{l}{r}$ for lengths over 55 radii.

Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, Inches. D	T	B	Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS. 10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.
	83.5	13 3/4	11/16	13.92	24.46	3.47	159.0	159.0	159.0	158.5	153.8
	91.0	13 7/8	3/4	13.96	26.76	3.49	173.9	173.9	173.9	173.6	168.5
	99.0	14	13/16	14.00	29.06	3.50	188.9	189.0	189.0	188.6	183.2
	106.5	14 1/8	7/8	14.04	31.38	3.52	204.0	204.0	204.0	204.0	198.1
	114.5	14 1/4	15/16	14.08	33.70	3.53	219.1	219.1	219.1	219.1	212.9
	122.5	14 3/8	1	14.12	36.04	3.55	234.3	234.3	234.3	234.3	228.0
	130.5	14 1/2	1 1/16	14.16	38.38	3.56	249.5	249.5	249.5	249.5	243.0
	138.0	14 5/8	1 1/8	14.19	40.59	3.58	263.8	263.8	263.8	263.8	257.4
	146.0	14 3/4	1 3/16	14.23	42.95	3.59	279.2	279.2	279.2	279.2	272.5
	154.0	14 7/8	1 1/4	14.27	45.33	3.61	294.7	294.7	294.7	294.7	288.1
	162.0	15	1 5/16	14.31	47.71	3.62	310.1	310.1	310.1	310.1	303.4
H14	170.5	15 1/8	1 3/8	14.35	50.11	3.64	325.7	325.7	325.7	325.7	319.0
	178.5	15 1/4	1 7/16	14.39	52.51	3.65	341.3	341.3	341.3	341.3	334.6
	186.5	15 3/8	1 1/2	14.43	54.92	3.66	357.0	357.0	357.0	357.0	350.3
	195.0	15 1/2	1 9/16	14.47	57.35	3.68	372.8	372.8	372.8	372.8	366.1
	203.5	15 5/8	1 5/8	14.51	59.78	3.69	388.6	388.6	388.6	388.6	381.9
	211.0	15 3/4	1 11/16	14.54	62.07	3.70	403.5	403.5	403.5	403.5	396.9
	219.5	15 7/8	1 3/4	14.58	64.52	3.71	419.4	419.4	419.4	419.4	412.9
	227.5	16	1 13/16	14.62	66.98	3.72	435.4	435.4	435.4	435.4	429.0
	236.0	16 1/8	1 7/8	14.66	69.45	3.74	451.4	451.4	451.4	451.4	445.2
	244.5	16 1/4	1 15/16	14.70	71.94	3.75	467.6	467.6	467.6	467.6	461.5
	253.0	16 3/8	2	14.74	74.43	3.76	483.8	483.8	483.8	483.8	477.9
	261.5	16 1/2	2 1/16	14.78	76.93	3.77	500.0	500.0	500.0	500.0	494.4
	270.0	16 5/8	2 1/8	14.82	79.44	3.79	516.4	516.4	516.4	516.4	510.9
	278.5	16 3/4	2 3/16	14.86	81.97	3.80	532.8	532.8	532.8	532.8	527.6
	287.5	16 7/8	2 1/4	14.90	84.50	3.81	549.3	549.3	549.3	549.3	544.3

For detail dimensions, see page 106.

SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL 14″ H COLUMNS.



SQUARE ENDS.

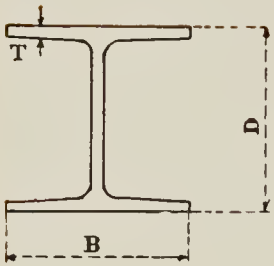
Allowable stress per square Inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000 - 55\ \frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Wgt. of Sec., lbs., per Foot
20 Ft.	**22** Ft.	**24** Ft.	**26** Ft.	**28** Ft.	**30** Ft.	**32** Ft.	**36** Ft.	**40** Ft.	**44** Ft.	
149.2	144.5	139.9	135.2	130.5	125.9	121.2	111.9	102.6	.....	83.5
163.4	158.4	153.3	148.2	143.2	138.1	133.1	122.9	112.8	.....	91.0
177.7	172.2	166.7	161.2	155.8	150.3	144.8	133.8	122.9	111.9	99.0
192.2	186.3	180.4	174.6	168.7	162.8	156.9	145.1	133.4	121.6	106.5
206.6	200.3	194.0	187.7	181.4	175.1	168.8	156.2	143.6	131.0	114.5
221.3	214.6	207.9	201.2	194.5	187.8	181.1	167.7	154.3	140.9	122.5
235.9	228.8	221.7	214.5	207.4	200.3	193.2	179.0	164.7	150.5	130.5
249.9	242.4	234.9	227.4	220.0	212.5	205.0	190.0	175.1	160.1	138.0
264.6	256.7	248.9	241.0	233.1	225.2	217.3	201.5	185.7	170.0	146.0
279.8	271.5	263.2	254.9	246.6	238.3	230.0	213.5	196.9	180.3	154.0
294.7	286.0	277.3	268.6	259.9	251.2	242.5	225.1	207.7	190.3	162.0
309.9	300.8	291.7	282.6	273.5	264.4	255.3	237.1	218.9	200.7	170.5
325.1	315.6	306.1	296.6	287.1	277.6	268.1	249.1	230.1	211.1	178.5
340.4	330.5	320.6	310.7	300.8	290.9	281.0	261.2	241.4	221.6	186.5
355.8	345.5	335.2	324.9	314.6	304.3	294.0	273.4	252.8	232.2	195.0
371.2	360.5	349.8	339.1	328.4	317.7	307.0	285.6	264.2	242.8	203.5
385.8	374.8	363.7	352.6	341.6	330.5	319.4	297.3	275.1	253.0	211.0
410.5	390.0	378.5	367.1	355.6	344.1	332.6	309.7	286.8	263.8	219.5
417.2	405.3	393.4	381.6	369.7	357.8	345.9	322.2	298.5	274.8	227.5
433.0	420.7	408.4	396.2	383.9	371.6	359.4	334.8	310.3	285.8	236.0
448.9	436.2	423.6	410.9	398.2	385.6	372.9	347.6	322.2	296.9	244.5
464.8	451.8	438.7	425.7	412.6	399.6	386.5	360.4	334.3	308.1	253.0
480.9	467.4	454.0	440.5	427.1	413.6	400.2	373.3	346.4	319.5	261.5
497.0	483.2	469.3	455.5	441.6	427.8	413.9	386.3	358.6	330.9	270.0
513.3	499.1	484.8	470.6	456.3	442.1	427.8	399.4	370.9	342.4	278.5
529.6	515.0	500.4	485.7	471.1	456.4	441.8	412.5	383.3	354.0	287.5

Loads to the right of the heavy line are for lengths greater than 125 radii.



SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

12″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch.

13,000 lbs. for lengths under 55 radii.

16,000-55 $\frac{l}{r}$ for lengths over 55 radii.

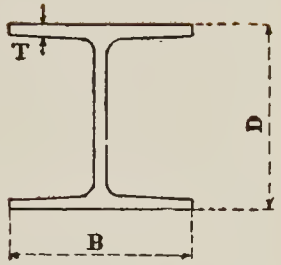
Section Number	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES.			Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.				
		D	T	B			**10** Ft	**12** Ft.	**14** Ft.	**16** Ft.	**18** Ft.
	64.5	11 3/4	5/8	11.92	19.00	2.98	123.5	123.5	122.5	118.3	114.1
	71.5	11 7/8	11/16	11.96	20.96	3.00	136.2	136.2	135.4	130.8	126.2
	78.0	12	3/4	12.00	22.94	3.01	149.1	149.1	148.3	143.3	138.3
	84.5	12 1/8	13/16	12.04	24.92	3.03	162.0	162.0	161.4	155.9	150.5
	91.5	12 1/4	7/8	12.08	26.92	3.04	175.0	175.0	174.5	168.6	162.8
	98.5	12 3/8	15/16	12.12	28.92	3.06	188.0	188.0	187.7	181.5	175.2
	105.0	12 1/2	1	12.16	30.94	3.07	201.1	201.1	201.0	194.3	187.7
H12	112.0	12 5/8	1 1/16	12.20	32.96	3.08	214.2	214.2	214.2	207.2	200.1
	118.5	12 3/4	1 1/8	12.23	34.87	3.10	226.7	226.7	226.7	219.6	212.1
	125.5	12 7/8	1 3/16	12.27	36.91	3.11	239.9	239.9	239.9	232.6	224.8
	132.5	13	1 1/4	12.31	38.97	3.13	253.3	253.3	253.3	246.0	237.8
	139.5	13 1/8	1 5/16	12.35	41.03	3.14	266.7	266.7	266.7	259.3	250.6
	146.5	13 1/4	1 3/8	12.39	43.10	3.15	280.2	280.2	280.2	272.6	263.5
	153.5	13 3/8	1 7/16	12.43	45.19	3.16	293.7	293.7	293.7	286.0	276.6
	161.0	13 1/2	1 1/2	12.47	47.28	3.18	307.3	307.3	307.3	299.7	289.9

For detail dimensions, see page 108.

SAFE LOADS IN TONS OF 2000 LBS. FOR,

BETHLEHEM ROLLED STEEL

14″ H COLUMNS.



SQUARE ENDS.

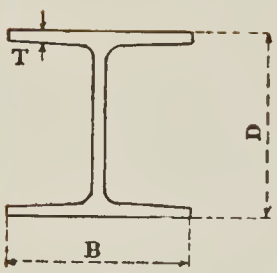
Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000 - 55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Wgt. of Sec., lbs., per Foot
20 Ft.	**22** Ft.	**24** Ft.	**26** Ft.	**28** Ft.	**30** Ft.	**32** Ft.	**34** Ft.	**36** Ft.	**38** Ft.	
109.9	105.7	101.5	97.3	93.1	88.9	84.7	80.5	76.3	.....	64.5
121.6	117.0	112.4	107.8	103.1	98.5	93.9	89.3	84.7	.....	71.5
133.2	128.2	123.2	118.1	113.1	108.1	103.0	98.0	93.0	.....	78.0
145.1	139.7	134.2	128.8	123.4	117.9	112.5	107.1	101.7	.....	84.5
156.9	151.1	145.2	139.4	133.5	127.7	121.9	116.0	110.2	104.3	91.5
169.0	162.8	156.5	150.3	144.0	137.8	131.6	125.3	119.1	112.8	98.5
181.0	174.4	167.7	161.1	154.4	147.8	141.1	134.4	127.8	121.1	105.0
193.1	186.0	178.9	171.9	164.8	157.7	150.7	143.6	136.6	129.5	112.0
204.7	197.3	189.9	182.5	175.0	167.6	160.2	152.8	145.3	137.9	118.5
217.0	209.1	201.3	193.5	185.6	177.8	170.0	162.1	154.3	146.5	125.5
229.6	221.4	213.2	204.9	196.7	188.5	180.3	172.1	163.9	155.6	132.5
242.0	233.4	224.8	216.1	207.5	198.9	189.3	181.6	173.0	164.4	139.5
254.5	245.5	236.4	227.4	218.4	209.3	200.3	191.3	182.3	173.2	146.5
267.1	257.7	248.3	238.8	229.4	219.9	210.5	201.1	191.6	182.2	153.5
280.1	270.3	260.5	250.7	240.9	231.0	221.2	211.4	201.6	191.8	161.0

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

10″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000\text{-}55\frac{l}{r}$ for lengths over 55 radii.

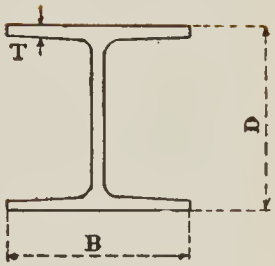
Section Number.	Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	DIMENSIONS, INCHES.			Least Radius of Gyration.	UNSUPPORTED LENGTH OF COLUMNS.				
			D	T	B		**10** Ft.	**11** Ft.	**12** Ft.	**13** Ft.	**14** Ft.
	49.0	9 7/8	9/16	9.97	14.37	2.49	93.5	93.5	92.1	90.2	88.3
	54.0	10	5/8	10.00	15.91	2.51	103.4	103.4	102.2	100.1	98.0
	59.5	10 1/8	11/16	10.04	17.57	2.53	114.2	114.2	113.1	110.8	108.5
	65.5	10 1/4	3/4	10.08	19.23	2.54	125.0	125.0	123.9	121.4	118.9
	71.0	10 3/8	13/16	10.12	20.91	2.56	135.9	135.9	134.9	132.2	129.5
	77.0	10 1/2	7/8	10.16	22.59	2.57	146.8	146.8	145.9	143.0	140.1
H10	82.5	10 5/8	15/16	10.20	24.29	2.58	157.9	157.9	157.0	153.9	150.8
	88.5	10 3/4	1	10.24	25.99	2.60	168.9	168.9	168.3	165.0	161.7
	94.0	10 7/8	1 1/16	10.28	27.71	2.61	180.1	180.1	179.6	176.1	172.6
	99.5	11	1 1/8	10.31	29.32	2.62	190.6	190.6	190.2	186.6	182.9
	105.5	11 1/8	1 3/16	10.35	31.06	2.64	201.9	201.9	201.9	198.0	194.1
	111.5	11 1/4	1 1/4	10.39	32.80	2.65	213.2	213.2	213.2	209.3	205.2
	117.5	11 3/8	1 5/16	10.43	34.55	2.66	224.6	224.6	224.6	220.7	216.4
	123.5	11 1/2	1 3/8	10.47	36.32	2.67	236.1	236.1	236.1	232.2	772.2

For detail dimensions, see page 110.

SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

10″ H COLUMNS.



SQUARE ENDS.

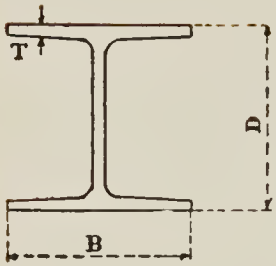
Allowable stress per square Inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000 - 55\,\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Wgt. of Sec., lbs. per Foot
15 Ft.	**16** Ft.	**18** Ft.	**20** Ft.	**22** Ft.	**24** Ft.	**26** Ft.	**28** Ft.	**30** Ft.	**32** Ft.	
86.3	84.5	80.7	76.9	73.1	69.3	65.4	61.6	57.8	54.0	49.0
95.9	93.8	89.6	85.4	81.3	77.1	72.9	68.7	64.5	60.3	54.0
106.2	103.9	99.3	94.7	90.1	85.6	81.0	76.4	71.8	67.2	59.5
116.4	113.9	108.9	103.9	98.9	93.9	88.9	83.9	78.9	73.9	65.5
126.9	124.2	118.8	113.4	108.0	102.6	97.2	91.8	86.4	81.0	71.0
137.2	134.3	128.5	122.7	116.9	111.1	105.3	99.5	93.7	87.9	77.0
147.7	144.6	138.4	132.2	126.0	119.8	113.5	107.3	101.1	94.9	82.5
158.4	155.1	148.5	142.0	135.4	128.8	122.2	115.6	109.0	102.4	88.5
169.1	165.6	158.6	151.6	144.6	137.6	130.6	123.6	116.6	109.6	94.0
179.2	175.5	168.1	160.7	153.3	145.9	138.5	131.2	123.8	116.4	99.5
190.3	186.4	178.6	170.8	163.1	155.3	147.5	139.8	132.0	124.2	105.5
201.2	197.0	188.9	180.7	172.5	164.4	156.2	148.0	139.9	131.7	111.5
212.1	207.8	199.2	190.7	182.1	173.5	165.0	156.4	147.8	139.2	117.5
223.2	218.7	209.8	200.8	191.8	182.8	173.8	164.9	155.9	146.9	123.5

Loads to the right of the heavy line are for lengths greater than 125 radii.



SAFE LOADS, IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

8″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square Inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000\text{-}55\frac{l}{r}$ for lengths over 55 radii.

Section Number.	Weight of Section, Lbs. per Foot	DIMENSIONS, INCHES			Area of Section, Square Inches	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.				
		D	T	B			8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.
	31.5	7 7/8	7/16	8.00	9.17	1.98	59.7	59.7	58.1	56.5	55.0
	34.5	8	1/2	8.00	10.17	2.01	66.1	66.1	64.7	63.0	61.3
	39.0	8 1/8	9/16	8.04	11.50	2.03	74.8	74.8	73.3	71.4	69.6
	43.5	8 1/4	5/8	8.08	12.83	2.04	83.4	83.4	81.9	79.8	77.7
	48.0	8 3/8	11/16	8.12	14.18	2.05	92.2	92.2	90.6	88.3	86.1
	53.0	8 1/2	3/4	8.16	15.53	2.07	101.0	101.0	99.5	97.0	94.5
H8	57.5	8 5/8	13/16	8.20	16.90	2.08	109.9	109.9	108.4	105.7	103.0
	62.0	8 3/4	7/8	8.24	18.27	2.09	118.8	118.8	117.3	114.4	111.5
	67.0	8 7/8	15/16	8.28	19.66	2.11	127.8	127.8	126.5	123.5	120.4
	71.5	9	1	8.32	21.05	2.12	136.8	136.8	135.6	132.4	129.1
	76.5	9 1/8	1 1/16	8.36	22.46	2.13	146.0	146.0	144.9	141.4	137.9
	81.0	9 1/4	1 1/8	8.39	23.78	2.14	154.6	154.6	153.6	149.9	146.2
	85.5	9 3/8	1 3/16	8.43	25.20	2.16	163.8	163.8	163.1	159.3	155.4
	90.5	9 1/2	1 1/4	8.47	26.64	2.17	173.2	173.2	172.6	168.6	164.5

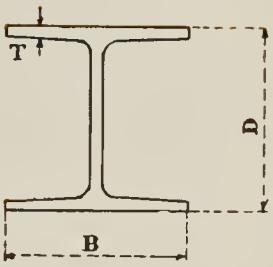
For detail dimensions, see page 112.

SAFE LOADS IN TONS OF 2000 LBS., FOR

BETHLEHEM ROLLED STEEL

8″ H COLUMNS.

SQUARD ENDS.



Allowable stress per square Inch:

13,000 lbs. for lenhths under 55 radii.

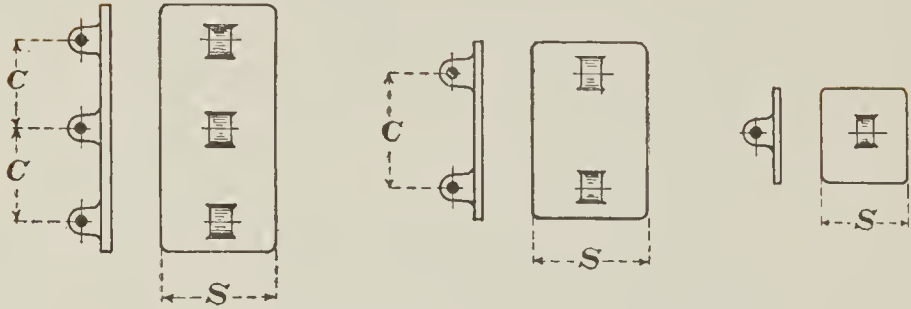
16,000-55$\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Wgt. of See., lbs. per Foot
13 Ft.	**14** Ft.	**15** Ft.	**16** Ft.	**17** Ft.	**18** Ft.	**20** Ft.	**22** Ft.	**24** Ft.	**26** Ft.	
53.5	52.0	50.4	48.9	47.4	45.9	42.8	39.7	36.7	.....	31.5
59.7	58.0	56.3	54.6	53.0	51.3	48.0	44.6	41.3	38.0	34.5
67.7	65.8	64.0	62.1	60.2	58.4	54.6	50.9	47.1	43.4	39.0
75.7	73.6	71.5	69.4	67.4	65.3	61.1	57.0	52.8	48.7	43.5
83.8	81.5	79.2	76.9	74.6	72.4	67.8	63.2	58.7	54.1	48.0
92.1	89.6	87.1	84.6	82.2	79.7	74.7	69.8	64.8	59.9	53.0
100.3	97.7	95.0	92.3	89.6	86.9	81.6	76.2	70.9	65.5	57.5
108.7	105.8	102.9	100.0	97.1	94.2	88.5	82.7	76.9	71.2	62.0
117.3	114.2	111.2	108.1	105.0	101.9	95.8	89.6	83.5	77.3	67.0
125.8	122.5	119.2	116.0	112.7	109.4	102.9	96.3	89.8	83.2	71.5
134.4	131.0	127.5	124.0	120.5	117.0	110.1	103.1	96.2	89.2	76.5
142.6	138.9	135.2	131.6	127.9	124.2	116.9	109.6	102.2	94.9	81.0
151.6	147.7	143.9	140.0	136.1	132.3	124.6	116.9	109.2	101.5	85.5
160.5	156.4	152.4	148.3	144.3	140.2	132.1	124.0	115.9	107.8	90.5

Loads to the right of the zigzag line are for lengths greater than 125 radii.

CAST IRON SEPARATORS FOR

BETHLEHEM GIRDER BEAMS.



Separators for 18 to 30 inch Beams are $\frac{5}{8}$ inch Metal.
Separators for 8 to 15 inch Beams are $\frac{1}{2}$ inch Metal.

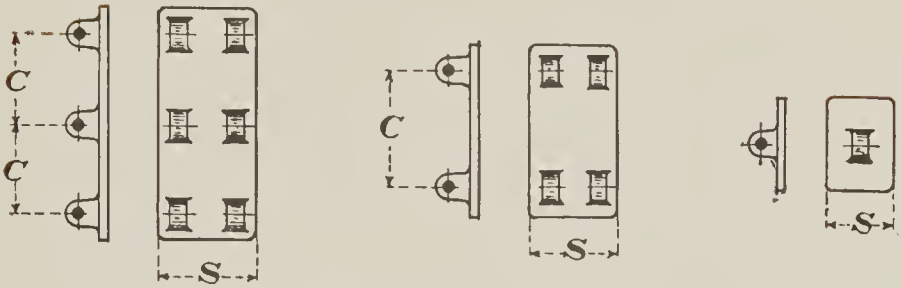
SEPARATORS WITH THREE BOLTS.

DESIGNATION OF BEAM.			DISTANCES.			BOLTS.		WEIGHTS IN POUNDS.			
								Separators.		Bolts and Nuts.	
Section Number.	Depth, Inches.	Weight per Foot, Pounds.	Out to Out of Flanges of Beams, Inches.	Center to Center of Beams, Inches.	Width of Separator, Inches. S	Center to Center, Inches. C	Length, Inches.	Separator for Width. S	Increase for 1" additional Spread of Beams.	Bolts and Nuts for Width. S	Increase for 1" additional Spread of Beams.
G30a	30	200.0	30 3/4	15 3/4	15	10	17 1/2	73.0	4.50	7.7	.375
G30	30	180.0	26 3/4	13 3/4	13	10	15 1/2	65.0	4.50	7.0	.375
G28a	28	180.0	29 3/8	15	14 1/4	7 1/2	16 3/4	65.0	4.15	7.4	.375
G28	28	165.0	23 3/4	13 1/4	12 5/8	7 1/2	15	60.0	4.15	6.8	.375
G26a	26	160.0	27 7/8	14 1/4	13 5/8	7 1/2	16	59.0	3.85	7.1	.375
G26	26	150.0	24 3/4	12 3/4	12 1/8	7 1/2	14 1/2	53.0	3.85	6.6	.375
SEPARATORS WITH TWO BOLTS.											
G24a	24	140.0	26 3/4	13 3/4	13 1/8	12 1/2	15 1/4	50.0	3.50	4.6	.25
G24	24	120.0	24 3/4	12 3/4	12 1/4	12 1/2	14 1/4	47.0	3.50	4.3	.25
G20a	20	140.0	25 1/2	13	12 3/8	10	14 3/4	39.0	2.80	4.5	.25
G20	20	112.0	24 1/2	12 1/2	12	10	14	38.0	2.80	4.3	.25
G18	18	92.0	23 1/2	12	11 1/2	10	13 1/2	34.0	2.60	4.2	.25
G15b	15	140.0	24	12 1/4	11 3/8	7 1/2	14	22.0	1.50	4.3	.25
G15a	15	104.0	23	11 3/4	11 1/8	7 1/2	13 1/2	22.0	1.60	4.2	.25
G15	15	73.0	21 1/2	11	10 1/2	7 1/2	12 1/2	21.0	1.60	4.0	.25
G12a	12	70.0	20 1/2	10 1/2	10	5	12	17.5	1.30	3.8	.25
G12	12	55.0	20 1/8	10 3/8	10	5	11 3/4	17.5	1.30	3.8	.25
SEPARATORS WITH ONE BOLT.											
G10	10	44.0	18 1/2	9 1/2	9 1/8	.....	10 3/4	11.0	1.10	1.8	.125
G9	9	38.0	17 1/2	9	8 3/4	.....	10 1/4	10.0	1.00	1.7	.125
G8	8	32.5	16 1/2	8 1/2	8 1/4	.....	9 3/4	8.0	.85	1.7	.125

All Bolts $\frac{3}{4}$ inch diameter.

CAST IRON SEPARATORS FOR

BETHLEHEM SPECIAL I BEAMS.



Separators for 18 to 30 inch Beams are 5/8 inch Metal.
Separators for 8 to 15 inch Beams are 1/2 inch Metal.

SEPARATORS WITH THREE BOLTS.

DESIGNATION OF BEAM.			DISTANCES.			BOLTS.		WEIGHTS IN POUNDS.			
								Separators.		Bolts and Nuts	
Section Number.	Depth, Inches.	Weight per Foot, Pounds.	Out to Out of Flanges of Beams, Inches.	Center to Center of Beams, Inches.	Width of Separator, Inches. S	Center to Center, Inches. C	Length, Inches.	Separator for Width. S	Increase for 1" additional Spread of Beams.	Bolts and Nuts for Width. S	Increase for 1" additional Spread of Beams.
B30	30	120.0	20 3/4	10 3/4	10 1/4	10	12 1/4	47.8	4.50	5.8	.375
B28	28	105.0	19 7/8	10 1/4	9 3/4	7 1/2	11 3/4	42.3	4.15	5.6	.375
B26	26	90.0	18 7/8	9 3/4	9 1/4	7 1/2	11 1/4	37.9	3.85	5.4	.375

SEPARATORS WITH TWO BOLTS.

B24a	24	84.0	18 3/16	9 3/8	8 7/8	12 1/2	10 3/4	33.7	3.65	3.5	.25
B24	24	73.0	18 1/4	9 1/4	8 7/8	12 1/2	10 3/4	33.7	3.65	3.5	.25
B20a	20	72.0	17 3/8	9	8 1/2	10	10 1/2	26.7	3.00	3.4	.25
B20	20	59.0	16 1/4	8 1/4	7 7/8	10	10	25.	3.00	3.2	.25
B18	18	48.5	15	7 3/4	7 3/8	10	9	21.4	2.70	3.1	.25
B15b	15	71.0	15 1/4	7 3/4	7 1/4	7 1/2	9 1/2	12.7	1.65	3.1	.25
B15a	15	54.0	14 1/2	7 1/2	7	7 1/2	9	12.3	1.65	3.1	.25
B15	15	38.0	14	7 1/4	7	7 1/2	8 1/2	13.3	1.80	3.0	.25
B12a	12	36.0	13 1/16	6 3/4	6 3/8	5	8	9.1	1.30	2.8	.25
B12	12	28.5	12 5/8	6 1/2	6 1/4	5	7 3/4	9.0	1.30	2.8	.25

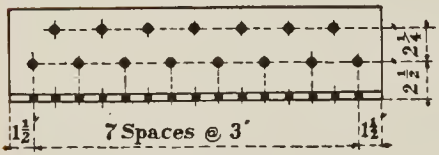
SEPARATORS WITH ONE BOLT.

B10	10	23.5	12 1/8	6 1/4	6	....	7 1/2	7.5	1.10	1.4	.125
B9	9	20.0	11 1/4	5 3/4	5 1/2	.....	7	6.4	1.00	1.3	.125
B8	8	17.5	10 7/8	5 5/8	5 3/8	.....	6 3/4	5.5	.85	1.3	.125

All Bolts 3/4 inch diameter.

CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS.

30″G.



92 lbs.
2-Ls-6x6x$\frac{7}{16}$″-2′-0″

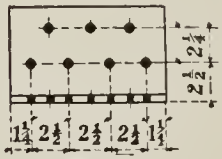
18″G.

49 lbs.
2-Ls-6x6x$\frac{7}{16}$″-1′-0$\frac{1}{2}$″

26″and 28″Gs.

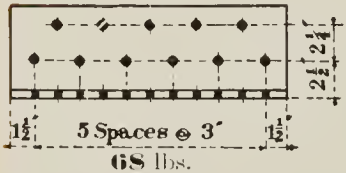
80 lbs.
2-Ls-6x6x$\frac{7}{16}$″-1′-9″

15′G.



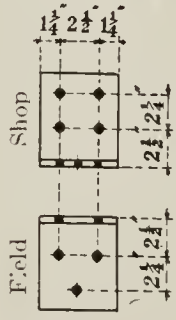
39 lbs.
2-Ls-6x6x$\frac{7}{16}$″-0′-10″

24″G.



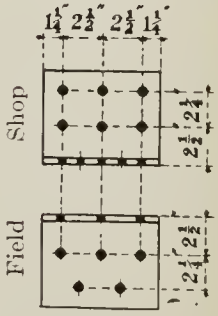
68 lbs.
2-Ls-6x6x$\frac{7}{16}$″-1′-6″

8′and 9′Gs.



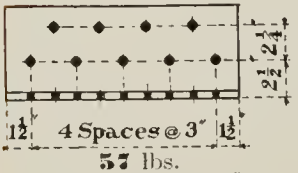
20 lbs.
2-Ls-6x6x$\frac{7}{16}$″-0′-5″

10″and 12′Gs.



30 lbs.
2-Ls-6x6x$\frac{7}{16}$″-0′-7$\frac{1}{2}$″

20′G.

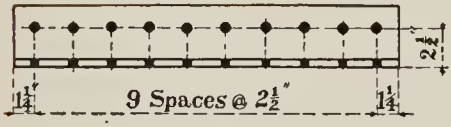


57 lbs.
2-Ls-6x6x$\frac{7}{16}$″-1′-3″

Spacing same in both legs of angles unless shown otherwise.
All holes $\frac{13}{16}$″ diameter, for $\frac{3}{4}$″ diameter rivets or bolts.

CONNECTION ANGLES FOR BETHLEHEM I BEAMS

30″ I.



56 lbs.
2–Ls 4x4x⅜″–2′-1″

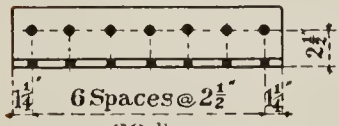
28″ I.

50 lbs.
2–Ls 4x4x⅜″–1′-10½″

26″ I.

45 lbs.
2–Ls 4x4x⅜″–1′-8″

24″ I

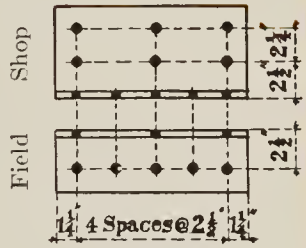


39 lbs.
2–Ls–4x4x⅜″–1′-5½″

20″ I.

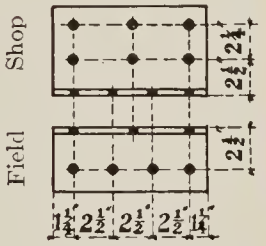
34 lbs.
2–Ls 4x4x⅜″–1′-3″

18″ I.



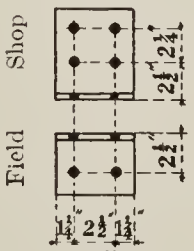
34 lbs.
2–Ls 6x4x⅜″–1′-0½″

15″ I.



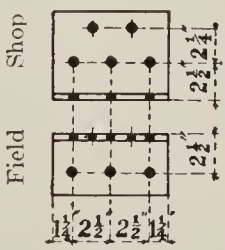
27 lbs.
2–Ls 6x4x⅜″–0′-10″

8″, 9″, and 10″ Is.



14 lbs.
2–Ls 6x4x⅜″–0′-5″

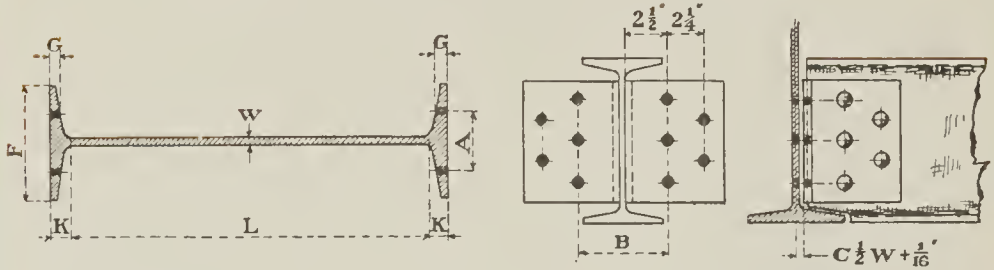
12″ I.



21 lbs.
2–Ls 6x4x⅜″–0′-7½″

Spacing same in both legs of angles unless shown otherwise.
All holes $\frac{13}{16}$″ diameter for ¾″ diameter rivets or bolts.

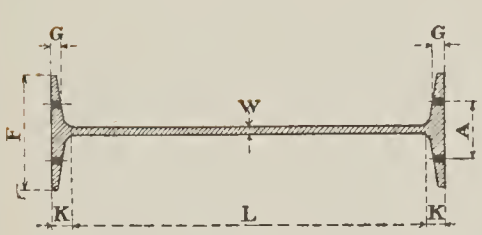
DETAIL DIMENSIONS FOR BFTHLEHEM GIRDER BEAMS

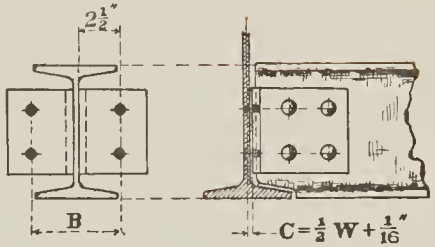


Section Number	Depth of Beam, Inches	Weight per Foot, Lbs.	DIMENSIONS, IN INCHES								Maximum Rivet or Bolt, Inch
			F	W	L	K	G	A	B	C	
G30a	30	200.0	15	3/4	25 3/16	2 13/32	1 1/8	11	5 3/4	7/16	1
G30	30	180.0	13	11/16	25 3/16	2 13/32	1 1/4	8	5 11/16	7/16	1
G28a	28	180.0	14 23/64	11/16	23 3/8	2 5/16	1 3/32	10 1/4	5 11/16	7/16	1
G28	28	165.0	12 1/2	21/32	23 3/8	2 5/16	1 3/16	8	5 11/16	3/8	1
G26a	26	160.0	13 39/64	5/8	21 5/8	2 3/16	1 1/16	9 1/2	5 5/8	3/8	1
G26	26	150.0	12	5/8	21 5/8	2 3/16	1 1/8	8	5 5/8	3/8	1
G24a	24	140.0	13	39/64	20	2	31/32	9	5 5/8	3/8	1
G24	24	120.0	12	17/32	20 1/4	1 7/8	29/32	8	5 1/2	5/16	1
G20a	20	140.0	12 1/2	41/64	15 3/4	2 1/8	1 1/8	8 1/2	5 5/8	3/8	1
G20	20	112.0	12	35/64	16 3/8	1 13/16	7/8	8	5 9/16	5/16	1
G18	18	92.0	11 1/2	31/64	14 3/4	1 5/8	25/32	7 1/2	5 1/2	5/16	1
G15b	15	140.0	11 3/4	51/64	10 1/8	2 7/16	1 9/32	7 3/4	5 13/16	7/16	1
G15a	15	104.0	11 1/4	39/64	11 1/8	1 15/16	15/16	7 1/4	5 5/8	3/8	1
G15	15	73.0	10 1/2	7/16	12	1 1/2	11/16	6 1/2	5 7/16	1/4	1
G12a	12	70.0	10	15/32	9	1 1/2	3/4	6	5 7/16	5/16	1
G12	12	55.0	9 3/4	3/8	9 1/2	1 1/4	19/32	6	5 3/8	1/4	1
G10	10	44.0	9	5/16	7 3/4	1 1/8	17/32	5 1/2	5 5/16	3/16	7/8
G9	9	38.0	8 1/2	5/16	6 7/8	1 1/16	15/32	5 1/4	5 5/16	3/16	7/8
G8	8	32.5	8	19/64	6	1	7/16	5	5 5/16	3/16	7/8

DETAIL DIMENSIONS FOR

BETHLEHEM I BEAMS

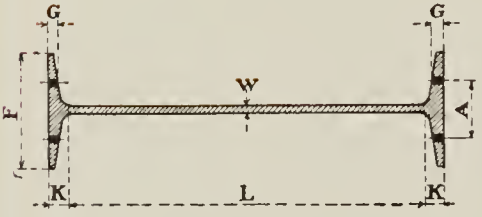


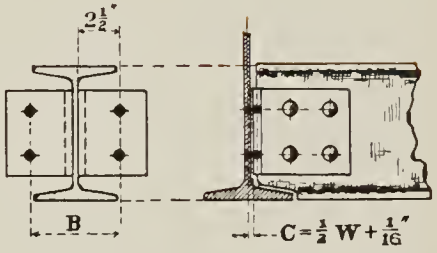


Section Number	Depth of Beam, Inches	Weight per Foot, Lbs.	DIMENSIONS, IN INCHES								Maximum Rivet or Bolt, Inch
			F	W	L	K	G	A	B	C	
B30	30	120.0	10 1/2	35/64	26 1/2	1 3/4	15/16	6	5 9/16	5/16	1
B28	28	105.0	10	1/2	24 3/4	1 5/8	7/8	5 3/4	5 1/2	5/16	1
B26	26	90.0	9 1/2	15/32	23	1 1/2	3/4	5 1/2	5 7/16	5/16	1
B24a	24	84.0	9 1/4	15/32	21	1 1/2	3/4	5 1/4	5 7/16	5/16	7/8
B24	24	83.0	9 1/8	33/64	21 1/4	1 3/8	11/16	5 1/4	5 1/2	5/16	7/8
	24	73.0		25/64	21 1/4	1 3/8	11/16	5 1/4	5 3/8	1/4	7/8
B20a	20	82.0	8 57/64	37/64	17 1/8	1 7/16	3/4	5	5 9/16	3/8	7/8
	20	72.0	8 3/4	7/16	17 1/8	1 7/16	3/4	5	5 7/16	1/4	7/8
B20	20	69.0	8 9/64	33/64	17 1/2	1 1/4	5/8	4 1/2	5 1/2	5/16	7/8
	20	64.0	8 5/64	29/64	17 1/2	1 1/4	5/8	4 1/2	5 7/16	5/16	7/8
	20	59.0	8	3/8	17 1/2	1 1/4	5/8	4 1/2	5 3/8	1/4	7/8
B18	18	59.0	7 43/64	1/2	15 3/4	1 1/8	9/16	4 1/4	5 1/2	5/16	7/8
	18	54.0	7 19/32	13/32	15 3/4	1 1/8	9/16	4 1/4	5 7/16	1/4	7/8
	18	52.0	7 9/16	3/8	15 3/4	1 1/8	9/16	4 1/4	5 3/8	1/4	7/8
	18	48.5	7 1/2	21/64	15 3/4	1 1/8	9/16	4 1/4	5 5/16	1/4	7/8

DETAIL DIMENSIONS FOR

BETHLEHEM I BEAMS





Section Number	Depth of Beam, Inches	Weight per Foot, Lbs.	DIMENSIONS, IN INCHES							Maximum Rivet or Bolt, Inches.
			F	W	L	K	G	A	B	C	
B15b	15	71.0	7 1/2	33/64	11 3/4	1 5/8	15/16	4	5 1/2	5/16	7/8
B15a	15	64.0	7 13/64	39/64	12 3/8	1 5/16	3/4	4	5 5/8	3/8	7/8
	15	54.0	7	13/32	12 3/8	1 5/16	3/4	4	5 7/16	1/4	7/8
	15	46.0	6 13/16	7/16	12 7/8	1 1/16	9/16	3 3/4	5 7/16	5/16	7/8
B15	15	41.0	6 23/32	11/32	12 7/8	1 1/16	9/16	3 3/4	5 5/16	1/4	7/8
	15	38.0	6 21/32	19/64	12 7/8	1 1/16	1/2	3 3/4	5 5/16	3/16	7/8
B12a	12	36.0	6 19/64	5/16	9 7/8	1 1/16	9/16	3 1/2	5 5/16	3/16	3/4
B12	12	32.0	6 3/16	5/16	10 1/8	15/16	7/16	3 1/2	5 5/16	1/4	3/4
	12	28.5	6 1/8	1/4	10 1/8	15/16	7/16	3 1/2	5 1/4	3/16	3/4
B10	10	28.5	5 63/64	25/64	8 3/8	13/16	3/8	3 1/4	5 3/8	1/4	3/4
	10	23.5	5 55/64	1/4	8 3/8	13/16	3/8	3 1/4	5 1/4	3/16	3/4
B9	9	24.0	5 9/16	23/64	7 1/2	3/4	3/8	3	5 3/8	1/4	3/4
	9	20.0	5 7/16	1/4	7 1/2	3/4	3/8	3	5 1/4	3/16	3/4
B8	8	19.5	5 21/64	21/64	6 5/8	11/16	5/16	2 3/4	5 5/16	1/4	3/4
	8	17 5	5 1/4	1/4	6 5/8	11/16	5/16	2 3/4	5 1/4	3/16	3/4

PART III

(Pages 141 to 211)

DEVOTED TO

ARCHITECTURAL WROUGHT AND CAST IRON

CONTAINING

TABLES OF SAFE LOADS FOR CAST IRON, ROUND AND RECTANGULAR COLUMNS, GAS PIPE COLUMNS AND CAST IRON LINTELS

DETAILS AND DATA FOR COLUMN CONNECTIONS AND BASES, WEIGHTS OF CAST COLUMNS AND PLATES

AND

CUTS OF SOME OF OUR STOCK PATTERNS FOR COLUMNS, PILASTERS, LEAF COLUMN CAPS, NEWEL POSTS, STAIR RAIL, CLEAN-OUT DOORS, MANHOLE AND COAL-HOLE FRAMES AND COVERS, ETC., ETC.

The patterns herein shown represent but a portion of our stock. We will be pleased to furnish further information regarding these patterns or other patterns which we have in stock.

FOUNDRY DEPARTMENT

To meet the increased demands of our trade we have remodeled and extended our foundry, which in point of size and equipment is unsurpassed in the Northwest. The foundry floor covers 40,000 square feet, exclusive of shipping and store rooms, and every facility known to modern foundry practice has been provided for manufacturing medium weight and heavy castings.

Our equipment includes a complete system of overhead travelers, operated by electricity, and covering the entire floor space, which enables us to handle all material rapidly and economically.

Our product is the best that modern scientific methods, combined with long experience and careful supervision, can produce, and we guarantee our castings to be true to pattern and of uniform quality.

EXPLANATION OF TABLES ON SAFE LOADS FOR CAST IRON COLUMNS

The loads in these tables are based on the following formulæ:

$$p = \frac{80000}{1 + \frac{(12L)^2}{800d^2}} \qquad \text{for round columns.}$$

$$p = \frac{80000}{1 + \frac{3(12L)^2}{3200d^2}} \qquad \text{for rectangular columns.}$$

In which—

p = pressure in pounds per square inch.
L = length in feet.
d = outside diameter or least side of rectangle in inches.
Factor of safety, 8.

It is assumed that the columns are set with the care usual in building work, that the bases have a fair bearing, and that the ends of the shafts are accurately turned to a true plane.

For diameters or lengths intermediate of those given in the table, the loads may be found by interpolation.

For practical purposes it may be assumed that the loads diminish in the same proportion as the thickness of the metal, the outer diameter remaining the same; but where the thickness is increased special calculations will be necessary unless the new thickness is less than $\frac{1}{8}$ of the outside diameter.

SAFE LOAD IN POUNDS FOR ROUND HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Outside Diameter	Thickness of Metal	Length of Column in Feet.							
		6	7	8	9	10	11	12	13
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4	½	39,000	35,400	31,900	28,800	25,900	23,300	21,300	19,000
	¾	54,400	49,400	44,500	40,000	36,000	32,400	29,100	26,400
	1	67,000	60,800	54,800	49,300	44,400	39,900	35,900	32,500
5	½	56,100	52,300	48,400	44,600	41,100	37,600	34,600	31,400
	¾	79,500	74,000	68,400	63,100	58,100	53,300	49,000	44,400
	1	99,800	92,800	85,900	79,300	73,000	66,900	61,500	55,800
6	¾	104,900	99,300	93,800	88,000	82,400	77,000	71,900	67,300
	1	133,100	126,100	119,000	111,800	104,600	97,800	91,400	85,400
	1 ¼	158,000	149,600	141,300	132,600	124,300	116,100	108,400	101,400
7	¾	130,000	124,900	119,600	113,400	107,800	101,500	96,100	90,800
	1	166,400	159,800	153,100	145,100	137,900	129,900	123,000	116,100
	1 ¼	199,300	191,400	183,500	173,900	165,100	155,500	147,400	139,100
8	¾	155,400	150,100	144,800	139,000	133,400	127,500	121,500	115,800
	1	200,300	193,400	186,500	179,000	171,800	164,100	156,500	149,000
	1 ½	278,800	269,100	259,600	249,300	239,100	228,600	217,900	207,500
9	¾	180,000	174,000	168,900	164,600	159,100	153,100	147,300	141,100
	1	232,500	226,500	220,000	213,000	205,800	197,900	190,400	182,500
	1 ¼	281,500	274,300	266,300	257,900	249,100	239,600	230,500	221,000
	1 ¾	368,700	359,300	348,800	337,900	326,400	313,900	302,000	289,500
10	¾	204,600	200,300	195,400	190,300	184,800	178,800	173,000	167,000
	1	265,500	259,900	253,500	246,700	239,600	231,900	224,500	216,800
	1 ¼	322,600	315,800	308,000	299,900	291,300	281,900	272,800	263,400
	1 ¾	425,900	416,800	406,500	395,800	384,400	372,000	360,000	347,600
11	1	298,100	292,600	286,800	280,400	273,400	266,300	258,400	250,600
	1 ¼	364,500	356,600	349,400	340,300	333,100	324,500	314,900	305,400
	1 ½	424,800	416,900	408,500	397,900	389,500	379,400	368,300	357,000
	2	536,500	526,600	516,000	502,600	492,000	479,300	465,100	451,000
12	1	329,500	324,800	318,800	313,600	306,300	299,400	292,000	284,300
	1 ¼	402,700	396,900	389,600	383,300	374,400	365,900	357,000	347,500
	1 ½	472,300	465,500	458,300	449,500	438,900	429,100	418,600	407,500
	2	600,000	591,400	581,800	570,900	557,600	545,000	531,800	517,600
13	1	362,600	357,900	353,100	347,000	340,900	333,900	326,800	319,300
	1 ¼	443,800	438,000	432,300	424,800	417,300	408,600	400,000	390,800
	1 ½	521,300	514,500	507,800	499,000	490,100	480,000	469,900	459,000
	2	665,000	656,400	647,800	636,500	625,300	612,300	599,400	585,500
14	1	395,800	391,100	386,500	381,400	374,300	368,100	361,000	354,300
	1 ¼	484,800	479,100	473,500	467,100	458,400	450,900	442,100	434,100
	1 ½	569,600	563,000	556,300	549,000	538,600	529,900	519,500	510,000
	2	729,100	720,600	712,100	702,800	690,500	678,300	665,000	652,800
15	1	427,400	423,000	418,500	413,100	406,300	401,500	394,400	387,300
	1 ¼	523,300	519,100	513,600	506,900	499,500	492,800	484,000	475,300
	1 ½	618,600	612,400	606,000	598,000	589,300	581,300	570,900	560,500
	2	793,300	785,000	776,900	766,600	755,500	745,300	732,500	718,800
16	1	459,300	453,400	450,400	445,600	439,800	433,900	428,600	421,000
	1 ¼	564,400	557,300	553,600	547,900	540,600	533,400	526,900	517,500
	1 ½	665,900	657,400	653,100	646,300	637,800	629,300	621,500	610,400
	2	858,000	847,000	841,500	832,800	821,800	810,800	800,800	786,500

SAFE LOAD IN POUNDS FOR ROUND HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Length of Column in Feet.						Weight of Col. Shaft Lbs. per Lineal foot	Thickness of Metal.	Outside Diameter.
14	16	18	20	22	24			
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds			
17,300	14,100	.....	.....	.....	.....	17.20	1/2	
23,900	19,800	.....	.....	.....	.....	24.00	3/4	4
29,500	24,300	.....	.....	.....	.....	29.50	1	
29,300	24,900	21,300	18,300	.....	.....	22.10	1/2	
41,400	35,300	30,000	25,800	.....	.....	31.30	3/4	5
52,000	44,300	37,600	32,400	.....	.....	39.30	1	
62,600	54,300	47,100	41,100	.....	.....	39.00	3/4	
79,500	68,900	59,900	52,300	.....	.....	49.10	1	6
94,400	81,900	71,100	62,000	.....	.....	58.30	1 1/4	
85,600	76,000	67,300	59,500	52,600	47,500	46.00	3/4	
109,600	97,400	86,000	76,100	67,400	60,800	59.00	1	7
131,300	166,000	103,600	91,100	80,800	72,900	70.60	1 1/4	
110,100	99,300	89,300	80,500	72,400	65,100	53.40	3/4	
141,900	127,900	115,000	103,600	93,300	83,900	69.10	1	8
197,600	178,000	160,000	144,400	129,800	116,800	95.80	1 1/2	
135,400	123,900	113,000	102,800	93,500	85,300	60.70	3/4	
175,000	160,300	146,100	132,900	121,000	110,300	78.60	1	
211,900	194,000	176,900	160,900	146,500	133,500	95.10	1 1/4	9
277,500	254,100	231.600	210,800	191,900	174,900	124.36	1 3/4	
161,000	149,000	137,600	126,800	116,100	107,600	68.00	3/4	
209,000	193,400	178,500	164,400	150,600	139,600	88.40	1	
253,900	235,000	217,000	199,800	183,000	169,800	107.40	1 1/4	10
335,100	310,100	286,600	263,600	241,500	224,000	142.00	1 3/4	
243,100	227,400	211,800	196,400	182,600	168,900	98.20	1	
296,300	277,100	258,300	244,500	223,500	205,800	120.10	1 1/4	
346,400	321,800	301,700	285,800	260,300	240,600	[140.00	1 1/2	11
437,500	409,300	381,000	361,000	328,800	304,000	176.80	2	
276,500	261,000	245,100	229,600	214,500	200,100	108.00	1	
338,000	319,000	299,600	280,600	262,300	244,900	131.40	1 1/4	
396,400	374,100	351,300	329,000	307,500	287,100	154.70	1 1/2	12
503,500	475,300	446,300	418,000	390,500	364,600	195.80	2	
311,800	295,800	279,800	264,100	248,500	233,100	117.53	1	
381,500	362,000	343,000	323,500	304,400	285,300	144.20	1 1/4	
448,100	425,100	402,000	379,800	357,500	335,100	169.40	1 1/2	13
571,800	542,400	513,000	484,500	456,000	427,500	216.00	2	
346,600	330,800	313,900	298,600	283,300	266,900	128.10	1	
424,600	405,500	386,000	365,800	347,000	326,900	156.50	1 1/4	
498,900	478,400	454,300	429,800	407,600	384,100	184.10	1 1/2 1 3/4	14
638,600	560,500	581,000	551,500	521,900	493,000	235.70	2	
381,300	364,100	349,300	333,300	317,000	300,900	137.50	1	
467,800	448,300	428,600	409,100	390,100	369,300	169.40	1 1/4	
550,000	527,100	505,600	482,500	458,800	435,500	198.90	1 1/2	15
707,500	678,000	648,300	618,600	588,100	558,400	255.30	2	
413,900	399,100	383,300	367,600	351,500	335,000	147.30	1	
508,800	490,800	471,100	452,000	432,100	411,900	181.00	1 1/4	
600,100	578,900	555,800	534,400	509,800	485,800	213.50	1 1/2	16
773,300	745,800	716,100	687,000	656,800	625,900	274.90	2	

SAFE LOAD IN POUNDS FOR SQUARE HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Side of Square.	Thickness of Metal.	Length of Column in Feet.							
		6	7	8	9	10	11	12	13
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4	1/2	53,800	49,500	45,400	41,500	37,900	34,500	31,600	.....
	3/4	75,000	69,000	63,300	57,900	52,800	48,100	44,000	40,100
5	5/8	91,500	86,400	81,300	76,100	71,000	66,000	61,500	57,100
	3/4	106,400	100,600	94,600	88,600	82,800	77,000	71,800	66,600
	7/8	120,800	114,100	107,300	100,400	93,600	87,100	81,300	75,500
6	3/4	138,800	132,800	127,300	121,000	115,000	108,300	102,100	96,500
	1	176,300	168,500	161,300	153,800	146,000	137,500	129,800	122,500
	1 1/4	209,300	200,100	191,500	182,600	173,400	163,300	154,100	145,500
7	3/4	170,600	165,000	159,400	153,300	147,000	140,600	134,100	128,000
	1	218,400	211,500	204,000	196,100	188,100	180,000	171,600	163,800
	1 1/4	261,600	253,400	244,400	236,300	225,400	215,600	205,600	196,300
8	3/4	202,000	197,100	191,600	185,600	179,400	173,100	166,600	160,900
	1	260,000	253,800	246,800	239,000	231,000	223,000	214,500	207,300
	1 1/4	313,500	305,900	297,400	288,100	278,500	268,800	258,600	249,800
9	3/4	233,200	228,600	223,600	218,100	211,900	205,800	199,500	193,400
	1	302,100	295,600	289,300	282,000	274,000	266,000	258,000	250,000
	1 1/2	424,200	415,600	406,800	396,600	385,400	374,100	362,900	351,600
10	3/4	264,400	260,100	255,300	249,800	244,500	237,600	232,000	225,800
	1	342,900	337,500	331,300	324,000	317,300	308,300	301,000	293,000
	1 1/2	485,800	477,500	469,300	459,000	449,500	436,800	426,500	415,000
	2	609,600	600,000	588,800	576,000	564,000	548,000	535,100	506,800
11	3/4	295,600	291,700	286,800	281,800	276,800	271,000	263,300	258,300
	1	384,500	379,500	373,000	366,500	360,000	352,500	343,000	336,000
	1 1/2	547,900	540,800	531,500	522,300	513,000	502,400	488,800	478,800
	2	692,100	683,100	671,400	659,600	648,000	634,500	617,400	604,900
12	3/4	326,100	322,400	318,100	313,500	308,400	302,900	297,400	294,900
	1	425,100	420,300	414,800	408,600	402,000	394,900	387,800	379,500
	1 1/2	608,800	601,600	593,800	585,100	575,600	565,400	555,300	543,400
	2	773,000	764,000	754,000	734,000	731,000	718,000	705,000	690,000
13	1	466,300	461,400	456,100	452,400	445,300	437,400	430,300	423,000
	1 1/4	570,600	564,800	558,900	553,800	544,900	535,400	526,500	517,800
	1 1/2	670,100	663,300	658,900	650,400	640,000	628,800	618,400	608,100
	2	854,800	845,900	837,100	829,400	816,300	801,900	788,800	775,500
14	1	507,000	503,800	497,900	492,000	486,300	479,800	472,500	465,400
	1 1/2	731,300	726,600	718,100	709,800	701,300	691,900	681,600	671,300
	2	936,000	930,000	919,300	908,400	897,600	885,500	872,500	859,300
15	1	548,100	543,900	538,300	533,400	527,800	521,500	514,500	508,300
	1 1/2	792,800	786,600	778,600	771,400	763,400	754,300	744,100	735,000
	2	1,017,900	1,010,000	999,800	990,600	980,300	968,500	955,500	943,800
16	1	588,000	584,300	581,300	575,300	569,300	564,000	557,300	550,500
	2	1,097,600	1,090,600	1,085,000	1,073,800	1,062,600	1,052,800	1,040,300	1,027,600
17	1	628,800	625,600	621,500	616,000	611,300	605,600	599,300	593,600
	2	1,179,000	1,173,000	1,165,500	1,155,000	1,146,000	1,135,500	1,123,500	1,113,000
18	1	669,800	666,400	662,100	657,000	652,800	646,900	640,900	635,000
	2	1,260,900	1,254,500	1,246,400	1,236,800	1,228,700	1,217,600	1,206,400	1,195,300
19	1	710,100	706,500	702,900	698,400	693,900	688,500	682,300	676,800
	2	1,341,000	1,334,500	1,327,800	1,319,300	1,310,800	1,300,500	1,287,400	1,278,400
20	1	750,500	746,800	743,900	739,100	734,400	729,600	723,900	718,300
	2	1,420,000	1,414,800	1,409,400	1,400,400	1,391,400	1,382,400	1,371,600	1,360,800

SAFE LOAD IN POUNDS FOR SQUARE HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Length of Column in Feet.						Weight lbs. of Column per foot of Length.	Thickness of Metal.	Side of Square.
14	16	18	20	22	24			
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds			
.....	.....	.....	.....	.....	.....	21.8	½	4
36,600	.....	.....	.....	.....	.....	30.4	¾	
53,100	.....	.....	.....	.....	.....	34.2	⅝	5
62,000	53,400	46,200	40,400	.....	.....	39.8	¾	
70,000	60,500	52,400	45,600	.....	.....	45.1	⅞	
90,800	80,400	71,100	63,000	56,100	.....	49.2	¾	6
115,300	102,000	90,200	80,000	71,200	.....	62.5	1	
136,900	121,100	107,100	95,000	84,600	.....	74.2	1¼	
121,600	110,100	98,800	89,200	79,700	72,400	58.6	¾	7
155,800	140,000	126,600	114,200	102,600	92,700	75.0	1	
186,500	168,900	151,900	136,900	122,800	111,000	89.8	1¼	
153,900	141,100	129,100	117,300	107,300	98,100	68.0	¾	8
198,100	181,600	166,200	151,500	138,200	126,300	87.5	1	
238,800	219,000	200,400	182,600	166,600	152,200	105.5	1¼	
187,100	173,200	160,600	148,500	136,700	126,200	77.3	¾	9
242,000	224,000	207,600	192,000	176,700	163,200	100.0	1	
293,000	271,200	251,400	232,500	214,100	197,600	121.0	1¼	
340,400	315,000	292,000	270,000	248,600	229,500	140.6	1½	
219,600	206,000	193,200	180,000	167,500	155,400	86.7	¾	10
284,900	267,200	250,600	233,500	217,400	201,600	112.5	1	
403,500	378,600	355,100	330,800	308,000	285,600	159.4	1½	
506,400	475,200	445,600	415,200	386,300	358,400	200.0	2	
252,100	239,500	225,600	212,500	199,500	186,000	96.1	¾	11
328,000	311,500	293,500	276,500	259,500	242,500	125.0	1	
467,400	443,700	418,100	393,700	368,700	345,000	178.1	1½	
590,400	560,700	528,200	497,500	467,100	436,500	225.0	2	
284,400	272,100	259,500	246,400	232,200	219,400	105.5	¾	12
370,800	354,700	338,200	321,200	303,000	285,500	137.5	1	
530,800	508,000	484,400	459,800	433,900	408,700	196.6	1½	
673,800	645,000	615,000	584,000	551,000	519,000	250.0	2	
415,800	398,400	381,000	363,000	345,600	328,500	150.0	1	13
508,900	487,600	466,400	444,200	423,000	402,500	183.6	1¼	
597,800	572,700	547,700	521,900	496,700	472,600	215.6	1½	
762,300	730,400	698,500	665,500	633,700	602,700	275.0	2	
458,300	444,600	425,100	406,900	390,000	372,500	162.5	1	14
661,300	641,200	613,100	586,900	562,500	537,100	234.4	1½	
846,000	820,700	784,700	751,200	720,000	687,600	300.0	2	
500,500	485,100	468,200	451,500	433,200	415,700	175.0	1	15
723,900	701,600	677,400	653,000	626,700	601,400	253.2	1½	
929,500	900,900	869,700	838,500	804,700	772,200	325.0	2	
543,800	528,700	512,200	495,000	477,700	459,700	187.5	1	16
1,015,000	987,000	956,200	924,000	891,600	858,200	350.0	2	
585,600	572,000	555,200	539,200	521,600	504,000	193.8	1	17
1,098,000	1,072,300	1,041,000	1,011,000	978,000	945,000	374.4	2	
628,100	614,500	599,200	582,200	565,200	548,200	212.5	1	18
1,182,400	1,156,700	1,128,000	1,096,000	1,064,000	1,032,000	400.0	2	
670,500	656,100	641,600	626,400	609,200	593,100	225.0	1	19
1,266,500	1,239,200	1,212,100	1,183,200	1,150,900	1,120,200	425.0	2	
712,500	699,200	685,000	669,700	652,600	636,500	237.5	1	20
1,350,000	1,324,700	1,297,700	1,269,000	1,236,600	1,206,000	450.0	2	

SAFE LOADS IN POUNDS FOR RECTANGULAR CAST IRON COLUMNS

Size in Inches.	Thickness of Metal.	Length of Column in Feet.							
		6	7	8	9	10	11	12	13
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4	¾	98,000	90,300	82,800	75,800	69,100	63,100	57,500	52,600
x	1	123,000	113,300	103,800	95,000	86,800	79,300	72,300	66,000
6	1¼	143,800	132,500	121,300	111,400	101,400	92,800	84,600	77,400
4	¾	121,100	111,400	102,100	93,500	85,400	78,000	71,100	65,000
x	1	153,800	141,500	129,800	118,800	108,500	99,000	90,300	82,500
8	1¼	182,600	168,000	154,100	141,000	128,900	117,500	107,100	98,000
4	¾	143,800	132,500	121,300	111,400	101,400	92,800	84,600	77,400
x	1	184,500	169,800	155,800	142,500	130,100	118,800	108,400	99,000
10	1¼	221,000	203,400	186,500	170,800	156,000	142,300	129,800	118,600
5	¾	131,500	124,400	117,000	109,500	102,100	95,000	88,600	82,300
x	1	167,000	158,000	148,500	139,000	129,800	120,800	112,500	104,500
7	1¼	198,300	187,600	176,300	165,000	154,100	143,400	133,600	124,000
5	¾	194,100	183,600	172,600	161,600	150,900	140,400	130,800	121,500
x	1	250,500	237,000	222,800	208,500	194,600	181,100	168,800	156,800
12	1¼	302,600	286,300	269,100	251,900	235,100	218,800	203,900	189,400
6	¾	165,300	158,000	151,100	144,100	136,900	128,900	121,600	114,900
x	1	211,500	202,100	193,500	184,500	175,000	165,000	155,600	147,000
8	1¼	253,300	242,300	231,800	221,000	209,900	197,600	186,500	176,100
6	¾	218,100	208,500	199,500	190,300	180,600	170,100	160,600	151,600
x	1	282,000	269,600	258,000	246,000	233,600	220,000	207,600	196,000
12	1¼	341,500	326,500	312,500	297,900	282,900	266,400	251,400	237,400
7	¾	213,900	204,900	200,000	190,100	182,300	174,400	166,300	158,600
x	1	276,000	264,400	258,000	245,300	235,100	225,000	214,500	204,800
10	1¼	333,500	319,500	311,800	296,400	284,100	271,900	259,100	247,400
7	¾	241,500	231,400	225,800	214,600	205,800	196,900	187,600	180,300
x	1	312,800	299,600	292,400	278,000	266,500	255,000	243,100	232,000
12	1¼	379,500	363,500	354,800	337,300	323,300	309,400	294,900	281,500
8	¾	257,800	251,500	244,500	236,900	228,900	221,000	212,600	205,400
x	1	334,400	326,300	317,300	307,400	297,000	286,600	275,900	266,900
12	1¼	406,500	396,500	385,500	373,500	360,900	348,400	335,300	323,600
8	¾	313,500	305,900	297,400	288,100	278,400	268,800	258,600	249,800
x	1	408,600	398,800	387,800	375,600	363,000	350,300	337,100	325,600
16	1¼	499,300	487,100	473,600	458,900	443,400	425,500	411,900	397,600
9	¾	275,600	270,300	264,500	257,800	250,500	243,100	235,900	228,600
x	1	358,100	351,000	343,400	334,900	325,400	315,900	306,400	296,900
12	1¼	435,900	427,300	418,000	407,600	396,000	384,500	372,900	361,400
9	¾	332,300	325,600	318,600	310,600	301,900	293,000	284,300	275,400
x	1	433,500	425,000	415,900	405,600	393,800	382,400	370,900	359,400
16	1¼	530,100	519,600	508,400	495,800	481,600	467,600	453,500	439,500
10	¾	350,000	344,500	338,100	331,100	323,400	315,600	307,300	299,000
x	1	457,300	450,000	441,300	432,600	422,400	412,300	401,400	390,600
16	1¼	559,600	550,800	540,500	529,400	517,000	504,500	491,300	478,100
10	¾	407,300	400,800	393,300	385,300	376,300	367,100	357,500	347,900
x	1	533,400	525,000	515,300	504,800	492,800	480,900	468,300	455,800
20	1¼	654,900	644,500	632,500	619,700	605,000	590,400	574,900	559,500
12	1	502,500	496,600	490,000	483,000	475,100	466,600	458,300	448,500
16	1¾	828,500	818,700	808,300	796,400	783,500	769,600	755,800	739,600
12	1	657,000	649,400	640,900	631,500	621,300	610,300	599,300	586,500
24	1¾	1,099,100	1,086,300	1,072,100	1,056,500	1,039,400	1,020,900	1,002,400	981,100

SAFE LOADS IN POUNDS FOR RECTANGULAR CAST IRON COLUMNS.

Length of Column in Feet.						Weight of Column Shaft per Lineal Foot.	Thickness of Metal.	Size in Inches.
14	16	18	20	22	24			
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds			
48,000	40,400	34,100	29,000	.....	.....	39.8	¾	4
60,300	50,600	42,800	36,400	.....	.....	50.0	1	x
70,600	59,300	50,000	42,600	.....	.....	58.6	1¼	6
59,300	49,800	42,100	35,900	.....	.....	49.2	¾	4
75,300	63,300	53,500	45,500	.....	.....	62.5	1	x
89,400	75,100	63,500	53,800	.....	.....	74.2	1¼	8
70,600	59,300	50,000	42,600	.....	.....	58.6	¾	4
90,300	75,900	64,300	54,600	.....	.....	75.0	1	x
108,100	90,900	76,900	65,400	.....	.....	89.8	1¼	10
76,400	66,000	57,100	49,800	43,800	38,300	49.2	¾	5
97,000	83,800	72,500	63,300	55,500	48,500	62.5	1	x
115,100	99,500	86,100	75,300	65,900	57,600	74.2	1¼	7
112,800	97,400	84,300	73,500	64,500	56,400	72.7	¾	5
145,500	125,600	108,800	94,900	83,300	72,800	93.8	1	x
175,800	151,800	131,400	114,600	100,500	87,900	113.3	1¼	12
108,000	95,500	84,500	75,000	66,800	59,300	58.6	¾	6
138,300	122,400	108,300	96,000	85,500	75,900	75.0	1	x
165,600	146,600	129,600	115,000	102,400	90,900	89.8	1¼	8
142,600	126,300	111,600	99,000	88,100	78,300	77.3	¾	6
184,400	163,300	144,400	128,000	114,000	101,300	100.0	1	x
223,300	197,600	174,900	155,000	138,000	122,500	121.1	1¼	12
151,500	136,600	122,600	110,600	99,400	89,800	72.7	¾	7
194,500	176,300	158,300	142,900	128,300	115,900	93.8	1	x
235,100	213,000	191,300	172,600	155,000	140,000	113.3	1¼	10
170,300	154,300	138,500	125,000	112,300	101,400	82.0	¾	7
220,600	199,800	179,400	161,900	145,400	131,400	106.3	1	x
267,600	242,400	217,600	196,500	176,400	159,400	128.9	1¼	12
196,400	180,000	164,800	150,300	137,000	125,300	86.7	¾	8
254,800	233,500	213,800	294,900	177,800	162,500	112.5	1	x
309,500	283,900	259,809	236,800	216,000	197,400	136.7	1¼	12
238,800	218,900	200,400	182,600	166,600	152,300	105.5	¾	8
311,300	285,500	261,300	238,100	217,300	198,500	137.5	1	x
379,300	348,800	319,100	290,900	265,400	242,500	168.0	1¼	16
221,300	204,800	189,800	175,500	161,600	149,100	91.4	¾	9
287,400	266,000	246,500	228,000	210,000	193,800	118.8	1	x
349,800	323,800	300,000	277,500	255,500	235,900	144.5	1¼	12
266,600	246,800	228,600	211,500	194,800	179,600	110.2	¾	9
347,800	322,000	298,400	276,000	254,100	234,600	143.8	1	x
425,400	393,800	364,900	337,500	310,800	286,900	175.8	1¼	16
290,400	272,900	255,300	238,400	222,400	207,100	114.8	¾	10
379,300	356,400	333,600	311,100	290,400	270,600	150.0	1	x
464,100	436,300	408,300	381,100	355,400	331,300	183.6	1¼	16
337,900	317,400	297,100	277,300	258,600	241,000	133.6	¾	10
442,400	415,800	389,300	363,300	338,800	315,800	175.0	1	x
543,100	510,800	477,800	446,000	415,900	387,600	214.9	1¼	20
438,100	419,300	399,800	379,600	358,100	337,400	162.5	1	12
537,100	514,000	490,100	465,400	439,400	413,600	199.2	1	x
722,500	691,500	659,400	626,000	590,600	556,400	268.0	1¾	16
572,900	548,300	523,000	496,400	468,400	441,100	212.5	1	12
706,400	677,300	645,800	612,500	578,600	545,000	261.7	1¼	x
958,400	917,100	874,500	830,400	783,800	738,000	355.5	1¾	24

SAFE LOADS FOR GAS PIPE COLUMNS

Based on formula $P = 11000 - 35\frac{l}{r}$. P = Pressure per square inch. l = length in inches. r = radius of gyration.

	Nominal Size	External Diamet'r	Internal Diamet'r	Thick-ness	Weight per Foot	Area of Section	LENGTH IN FEET				
							8	**9**	**10**	**12**	**14**
	Inches	Inches	Inches	Inches	Pounds	Sq. In.	Pounds	Pounds	Pounds	Pounds	Pounds
Standard Pipe	**2½**	2.875	2.468	.204	5.74	1.59	11800	11000	10400	.....	.....
	3	3.5	3.067	.217	7.54	2.26	18300	17500	16700	15000	.....
	3½	4.0	3.548	.226	9.00	2.59	22000	21300	20500	18800	17200
	4	4.5	4.026	.237	10.66	3.33	28900	28200	27300	25400	23600
	4½	5.00	4.508	.247	12.34	3.73	33600	32600	31800	29800	28000
	5	5.563	5.045	.259	14.50	4.17	37500	37500	36500	34600	32500
	6	6.625	6.065	.280	18.76	5.57	50100	50100	50100	48800	46600
	7	7.625	7.023	.301	23.37	7.18	64600	64600	64600	64600	62600
	8	8.625	7.982	.322	28.18	8.14	73200	73200	73200	73200	73200
XX Pipe	**2½**	2.875	1.755	.56	13.68	4.09	28200	26000	23700	.....	.....
	3	3.50	2.284	.608	18.56	5.52	42500	40200	38000	33100	.....
	3½	4.00	2.716	.642	22.75	6.63	54400	52000	49700	45000	39800
	4	4.50	3.136	.682	27.48	8.33	70600	68300	65700	60400	55000
	5	5.563	4.063	.75	38.12	11.73	105600	102600	99900	94100	88300
	6	6.625	4.875	.875	53.11	15.80	142200	142200	141200	134000	128400

Except in special cases gas pipe columns are more expensive and less satisfactory than cast iron columns.

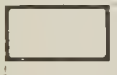
Where beams are supported at the side, brackets are fastened with tap screws, making a connection neither safe nor economical.

Cast flanges screwed to the shaft are used for making the connection between columns.

Columns of this type may be used to advantage, however, where the loads are light and rest on top of the column, the cap and base plates being loose.

WEIGHTS OF SQUARE OR RECTANGULAR CAST IRON COLUMN SHAFTS PER LINEAL FOOT

Example: Column 6″ x 12″ x 1″, 12′ 0″.
$2 \times (6'' + 12'') = 36''$. Opposite 36 and under thickness of 1″ find 100 lbs. weight per lineal foot. 100 lbs. × 12′ 0″ = 1200 lbs., weight of column shaft.



	THICKNESS OF METAL IN INCHES											
$2a + 2b$	5/8″	3/4″	7/8″	1″	1 1/8″	1 1/4″	1 3/8″	1 1/2″	1 5/8″	1 3/4″	1 7/8″	2″
12	18.6	21.1	23.3	25.0	26.4	27.3	27.9	28.1	.....	.....	.....	.....
14	22.5	25.8	28.7	31.3	33.4	35.1	36.5	37.5	.....	.....	.....	.....
16	26.4	30.5	34.2	37.5	40.4	43.0	45.0	46.9	48.1	49.2	49.3	50.0
18	30.3	35.2	39.7	43.8	47.4	50.8	53.6	56.3	58.3	60.2	61.6	62.5
20	34.2	39.8	45.1	50.0	54.5	58.6	62.3	65.6	68.4	71.1	73.3	75.0
22	38.1	44.5	50.6	56.3	61.5	66.4	70.8	75.0	78.5	82.0	85.0	87.5
24	42.0	49.2	56.1	62.5	68.5	74.2	79.4	84.4	88.7	93.0	96.7	100.0
26	45.9	53.9	61.5	68.8	75.6	82.0	87.9	93.8	98.8	103.9	108.4	112.5
28	49.8	58.6	67.0	75.0	82.6	89.8	96.5	103.7	109.0	114.8	120.1	125.0
30	53.7	63.3	72.5	81.3	89.6	97.7	105.2	112.5	119.1	125.8	131.8	137.5
32	57.6	68.0	77.9	87.5	96.7	105.5	113.7	121.9	129.2	136.7	143.5	150.0
34	61.5	72.7	83.4	93.8	103.7	113.3	122.3	131.3	139.4	147.7	155.2	162.5
36	65.4	77.3	88.9	100.0	110.7	121.1	130.8	140.6	149.5	158.6	166.9	175.0
38	69.3	82.0	94.3	106.3	117.8	128.9	139.4	150.0	159.7	169.5	178.6	187.5
40	73.2	86.7	99.8	112.5	124.8	136.7	148.0	159.4	169.8	180.5	190.3	200.0
42	77.1	91.4	105.3	118.8	131.8	144.5	156.6	168.8	179.9	191.4	202.0	212.5
44	81.0	96.1	110.8	125.0	138.8	152.3	165.2	178.1	190.1	202.3	213.7	225.0
46	84.9	100.8	116.2	131.3	145.9	160.2	173.7	187.5	200.2	213.3	225.4	237.5
48	88.8	105.5	121.7	137.5	152.9	168.0	182.3	196.9	210.4	224.2	237.1	250.0
50	92.8	110.2	127.2	143.8	159.9	175.8	190.9	206.3	220.5	235.2	248.8	262.5
52	96.7	114.8	132.6	150.0	167.0	183.6	199.5	215.6	230.6	246.1	260.5	275.0
54	100.6	119.5	138.1	156.3	174.0	191.4	208.1	225.0	240.8	257.0	272.2	287.5
56	104.5	124.2	143.6	162.5	181.0	199.2	216.6	234.4	250.9	268.0	283.9	300.0
58	108.4	128.9	149.0	168.8	188.1	207.0	225.2	243.8	261.1	278.9	295.6	312.5
60	112.3	133.6	154.5	175.0	195.1	214.9	233.8	253.2	271.2	289.8	307.3	325.0
62	116.2	138.3	160.0	181.3	202.1	222.7	242.4	262.5	281.3	300.8	319.0	337.5
64	120.1	143.0	165.4	187.5	209.2	230.5	251.2	271.9	291.5	311.7	330.7	350.0
66	121.0	147.7	170.9	193.8	216.2	238.3	259.5	281.3	301.6	322.7	342.4	362.5
68	127.9	152.3	176.4	200.0	223.2	246.1	268.1	290.6	311.8	333.6	354.1	375.0
70	131.8	157.0	181.8	206.3	230.3	253.9	276.7	300.0	321.9	344.5	365.8	387.5
72	135.7	161.7	187.3	212.5	237.3	261.7	285.3	309.4	332.0	355.5	377.5	400.0
74	139.6	166.4	192.8	218.8	244.3	269.5	293.9	318.8	342.2	366.4	389.2	412.5
76	143.5	171.1	198.3	225.0	251.3	277.3	302.5	328.1	352.3	377.3	400.9	425.0
78	147.4	175.8	203.7	231.3	258.4	285.2	311.0	337.5	362.5	383.3	412.6	437.5
80	151.3	180.5	209.2	237.5	265.4	293.0	319.6	346.9	372.6	399.2	424.3	450.0

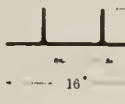
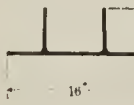
WEIGHTS OF CAST IRON RECTANGULAR PLATES 1 INCH THICK

WEIGHT OF 1 CUBIC INCH OF CAST IRON, 0.26 LBS.

Length in inches	WIDTH IN INCHES											
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**28**	**30**	**36**
4	4.16	6.25	8.3	10.4	12.5	14.6	16.6	18.7	20.8	25	29	31	37
5	5.21	7.81	10.4	13.2	15.6	18.2	20.8	23.4	26.0	31	36	39	47
6	6.25	9.37	12.5	15.6	18.7	21.8	25.0	28.1	31.2	38	44	47	56
7	6.29	10.94	14.6	18.2	21.9	25.5	29.2	32.8	36.5	44	51	55	66
8	8.33	12.50	16.6	20.8	25.0	29.2	33.3	37.5	41.6	50	58	62	75
9	9.37	14.06	18.7	23.4	28.1	32.8	37.5	42.2	46.9	56	66	70	84
10	10.42	15.62	20.8	26.0	31.2	36.5	41.7	46.9	52.1	63	73	78	94
11	11.46	17.19	22.9	28.6	34.4	40.1	45.8	51.6	57.3	69	80	86	103
12	12.50	18.75	25.0	31.2	37.5	43.7	50.0	56.2	62.5	75	88	94	112
14	14.58	21.87	29.2	36.5	43.7	51.0	58.3	65.6	72.9	88	102	109	131
16	16.67	25.00	33.3	41.7	50.0	58.3	66.7	75.0	83.3	100	117	125	150
18	18.75	28.12	37.5	46.9	56.2	65.6	75.0	84.4	93.7	112	131	141	169
20	20.83	31.25	41.6	52.1	62.5	72.9	83.3	93.7	104.2	125	146	156	188
22	22.92	34.37	45.8	57.3	68.7	80.2	91.7	103.1	114.6	138	160	172	206
24	25.00	37.50	50.0	62.5	75.0	87.5	100.0	112.5	125.0	150	175	187	225
26	27.08	40.62	54.2	67.7	81.2	94.8	108.3	121.9	135.4	162	190	203	224
28	29.17	43.75	58.3	72.9	87.5	102.1	116.7	131.2	145.8	175	204	219	263
30	31.25	46.87	62.5	78.1	93.7	109.4	125.0	140.6	156.2	187	219	234	281
32	33.33	50.00	66.7	83.3	100.0	116.7	133.3	150.0	166.7	200	233	250	300
34	35.42	53.12	70.8	88.5	106.2	124.0	141.7	159.4	177.1	212	248	266	319
36	37.50	56.25	75.0	93.7	112.5	131.2	150.0	168.7	187.5	225	263	281	337
38	39.58	59.37	79.2	99.0	118.7	138.5	158.3	178.1	197.9	237	277	297	356
40	41.67	62.50	83.3	104.2	125.0	145.8	166.7	187.5	208.3	250	292	312	375
42	43.75	65.62	87.5	109.4	131.2	153.1	175.0	196.9	218.7	262	306	328	394
44	45.83	68.75	91.7	114.6	137.5	160.4	183.3	206.2	229.2	275	321	344	412
46	47.92	71.87	95.8	119.8	143.7	167.7	191.7	215.6	239.6	287	335	359	431
48	50.00	75.00	100.0	125.0	150.0	175.0	200.0	245.0	250.0	300	350	375	450
50	52.08	78.12	104.2	130.2	156.2	182.3	208.3	234.4	260.4	312	365	391	469
52	54.16	81.25	108.3	135.4	162.5	189.6	216.7	243.7	270.8	325	379	406	487
54	56.25	84 37	112.5	140.6	168.7	196.9	225.0	253.1	281.2	337	394	422	506

CAST IRON LINTELS

Safe loads in pounds uniformly distributed for cast iron lintels. Allowable fiber stress, 3000 pounds per square inch.
Safe load includes weight of lintel.

Sketch of Section	SIZES	SPAN IN FEET					
	Height Width Metal	5	6	7	8	9	10
	6″ x 6″ x ¾″	6350	5380	4590	4010	3570	3100
	6″ x 6″ x 1 ″	7620	6350	5440	4760	4230	3810
	6″ x 6″ x 1¼″	8740	7360	6340	5520	4810	4320
	8″ x 6″ x ¾″	7880	6570	5630	4920	4370	3940
	8″ x 6″ x 1 ″	8790	6820	5850	5220	4700	4090
	8″ x 6″ x 1¼″	10320	8600	7370	6450	5730	5160
	8″ x 8″ x ¾″	12510	10430	8950	7820	6950	6260
	8″ x 8″ x 1 ″	15080	12570	10770	9430	8380	7540
	8″ x 8″ x 1¼″	17390	14490	12420	10870	9660	8690
	12″ x 6″ x ¾″	12800	10670	9140	8000	7110	6400
	12″ x 6″ x 1 ″	15310	12760	10950	9570	8500	7653
	12″ x 6″ x 1¼″	17320	14430	12370	10820	9610	8660
	12″ x 8″ x ¾″	20150	16810	14400	12190	11190	10080
	12″ x 8″ x 1 ″	24460	20630	17470	15290	13590	12230
	12″ x 8″ x 1¼″	33050	27530	23600	20630	18360	16520
	16″ x 6″ x ¾″	15830	13220	11300	9860	8790	7900
	16″ x 6″ x 1 ″	18890	15740	13500	11800	10490	9440
	16″ x 6″ x 1¼″	21210	17670	15150	13260	11800	10600
	16″ x 8″ x ¾″	24400	20350	17430	15240	13570	12200
	16″ x 8″ x 1 ″	30220	25180	21590	18880	16790	15110
	16″ x 8″ x 1¼″	34900	29080	24930	21810	19390	17450
	16″ x 10″ x ¾″	34280	28500	24500	21400	19040	17140
	16″ x 10″ x 1 ″	42800	35690	30500	26750	23800	21400
	16″ x 10″ x 1¼″	50190	41840	35840	31380	27880	25120

BASES FOR CAST IRON COLUMNS

Size of Column	Thickness of Metal	Size of Plate (Ordinary Masonry)	Weight	Size of Plate (Cut Stone)	Weight
5	3/4	14 x 14 x 1 3/4	90 lbs.	10 x 10 x 1 1/2	40 lbs.
5	1	16 x 16 x 2 1/4*	110 "	12 x 12 x 2	75 "
6	3/4	16 x 16 x 2*	105 "	12 x 12 x 1 3/4	65 "
6	1	18 x 18 x 2 1/2*	165 "	14 x 14 x 2 1/4	115 "
7	3/4	18 x 18 x 2 1/4*	140 "	14 x 14 x 2	105 "
7	1	20 x 20 x 2 1/2*	205 "	16 x 16 x 2 1/2*	135 "
8	3/4	20 x 20 x 2 3/4*	230 "	16 x 16 x 2 1/4*	125 "
8	1 1/4	24 x 24 x 6	330 "	18 x 18 x 2 3/4*	185 "
9	1	24 x 24 x 6	270 "	18 x 18 x 2 1/2*	175 "
9	1 1/2	30 x 30 x 8	555 "	20 x 20 x 2 3/4*	235 "
10	1	28 x 28 x 7	360 "	20 x 20 x 2 3/4*	235 "
10	1 1/2	32 x 32 x 10	715 "	24 x 24 x 6	370 "
11	1	30 x 30 x 8	420 "	24 x 24 x 6	270 "
11	1 1/2	36 x 36 x 10	840 "	28 x 28 x 7	490 "
12	1	32 x 32 x 10	515 "	28 x 28 x 7	360 "
12	1 1/2	38 x 38 x 12	1020 "	30 x 30 x 8	570 "

Bases marked thus * are beveled to 1/2 thickness shown.

Bases of greater thickness than 2 3/4 inches will be ribbed.

Above sizes are based on a pressure of 250 pounds per square inch for masonry and 500 pounds per square inch for cut stone.

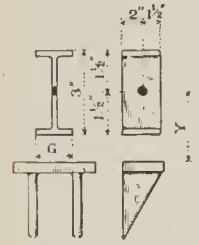
Bases for columns less than 8 feet in length and loaded to full safe load and bases for columns of thicker metal than sizes shown by more than 1/4 inch will require special calculation.

Thickness of metal in ribbed bases same as thickness of metal in columns.

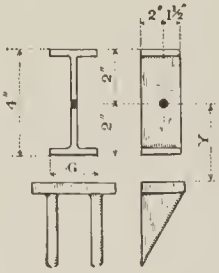
Weights of ribbed bases are approximate only.

STANDARD CONNECTIONS FOR I-BEAMS TO CAST IRON COLUMNS

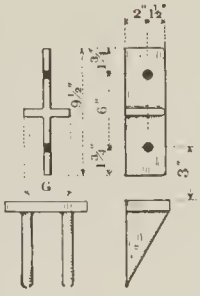
Details of Connecting Brackets for Double I-Beams



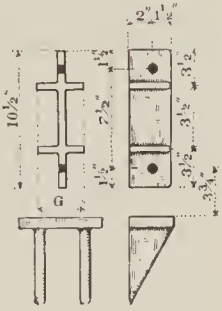
Y=2½″ for 5″ Beam
Y=3 ″ for 6″ Beam
Y=3½″ for 7″ Beam
5″, 6″, 7″ I-Beam



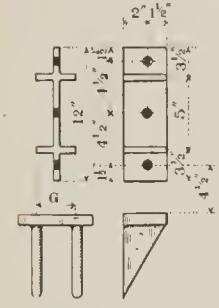
Y=4 ″ for 8″ Beam
Y=4½″ for 9″ Beam
Y=5 ″ for 10″ Beam
8″, 9″, 10″ I-Beam



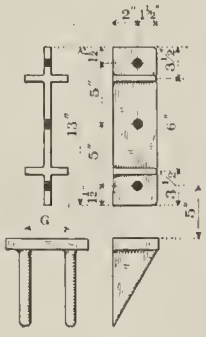
12″ I-Beam



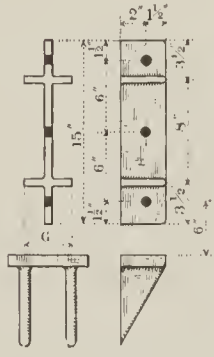
15″ I-Beam



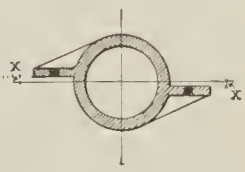
18″ I-Beam



20″ I-Beam



24″ I-Beam



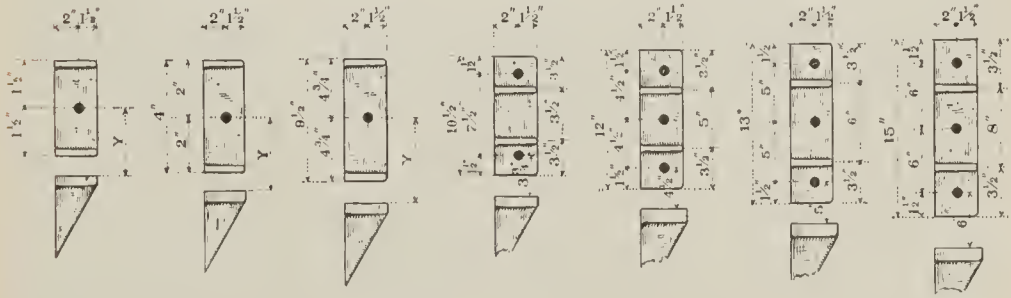
Thickn's of Connect'g Lugs
5″, 6″, 7″ I-Beams, ⅜″
8″, 9″, 10″, 12″ " ¾″
15″ I-Beams ..... ⅞″
18″, 20″, 24″ I-Beams, 1 ″

$$X = \frac{\text{Web}}{2} + \frac{1}{16}$$

G=Ctr. to Ctr. of Beams + (Web thickness + 1/16)

All holes cored for ¾″ bolts. The thickness of metal in brackets equals thickness of metal in columns.

Details of Connecting Brackets for Single I-Beams



Y=2½″ for 5″ Beam
Y=3 ″ for 6″ Beam
Y=3½″ for 7″ Beam
5″, 6″, 7″ I-Beam.

Y=4 ″ for 8″ Beam
Y=4½″ for 9″ Beam
Y=5 ″ for 10″ Beam
8″, 9″, 10″ I-Beam.

12″ I-Beam.

15″ I-Beam.

18″ I-Beam.

20″ I-Beam.

24″ I-Beam.

POST CAPS, BASES AND QUILLS

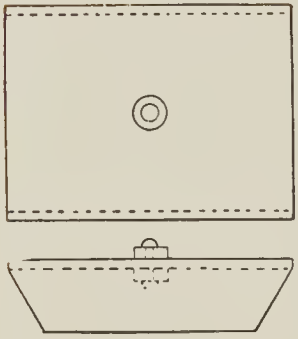


Fig. 31

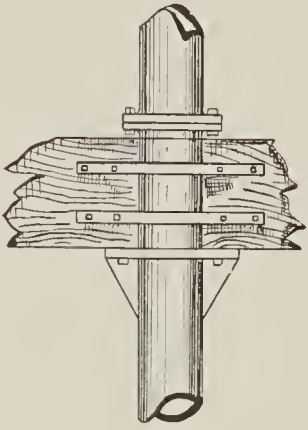


Fig. 33

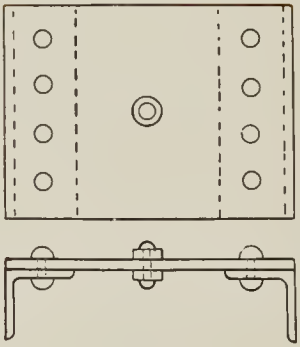


Fig. 32

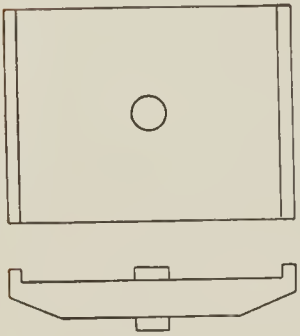


Fig. 34

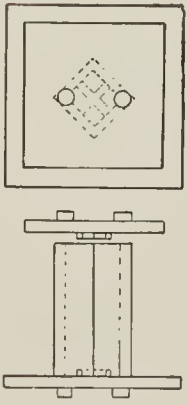
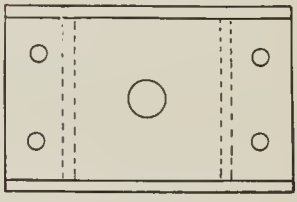


Fig. 36



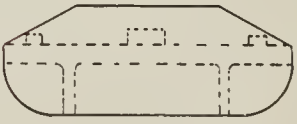


Fig. 35

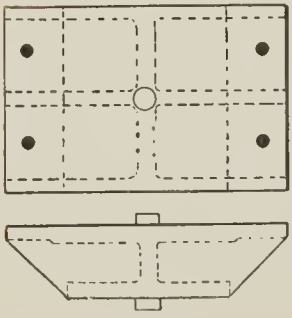


Fig. 37

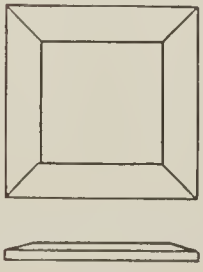


Fig. 38

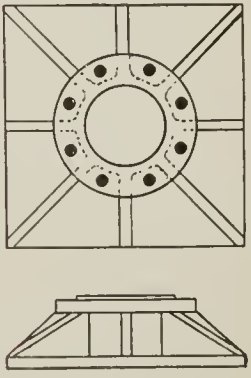
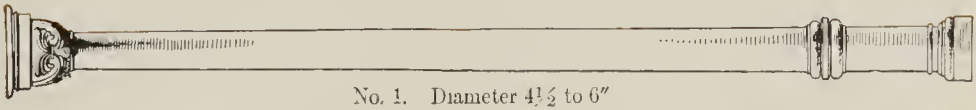
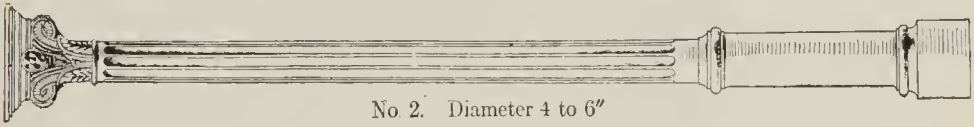


Fig. 39

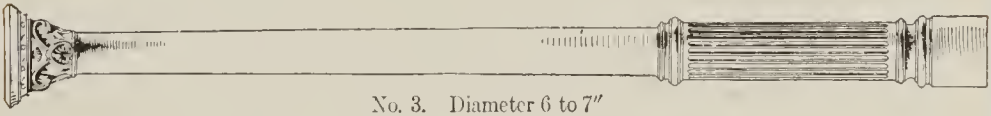
ORNAMENTAL ROUND COLUMNS



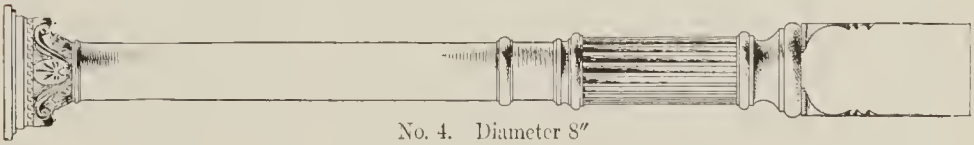
No. 1. Diameter 4½ to 6″



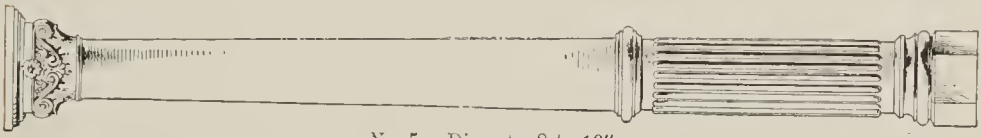
No. 2. Diameter 4 to 6″



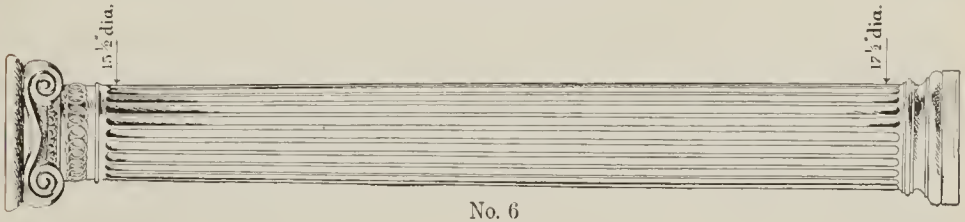
No. 3. Diameter 6 to 7″



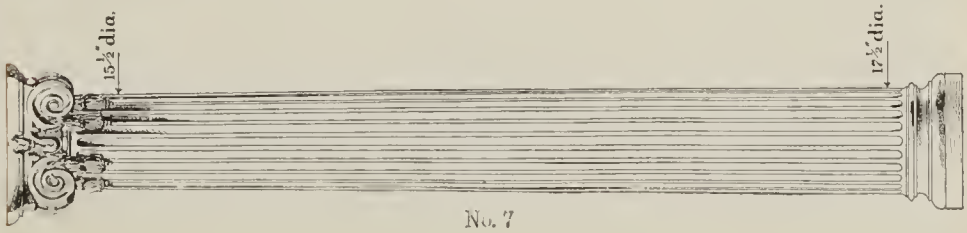
No. 4. Diameter 8″



No. 5. Diameter 8 to 10″

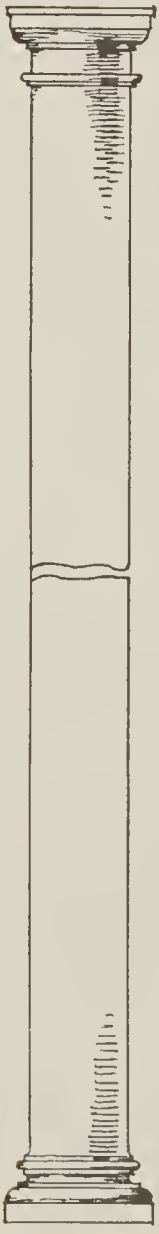


No. 6

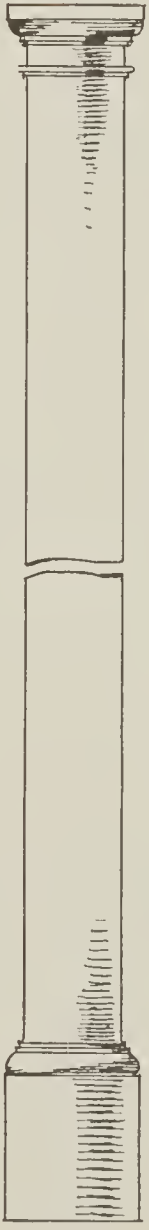


No. 7

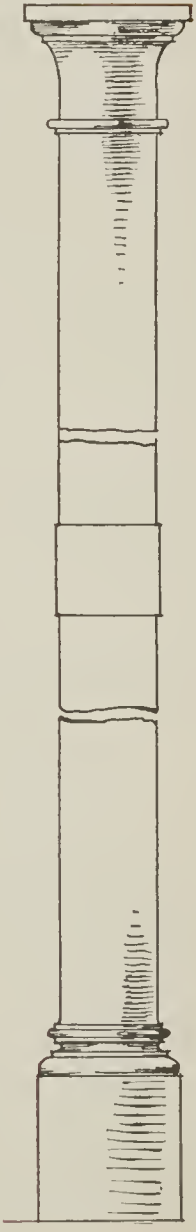
ORNAMENTAL ROUND COLUMNS



No. 8



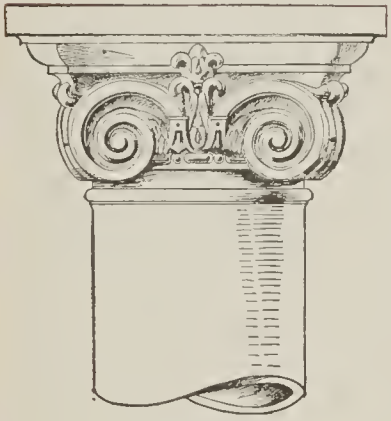
No. 9



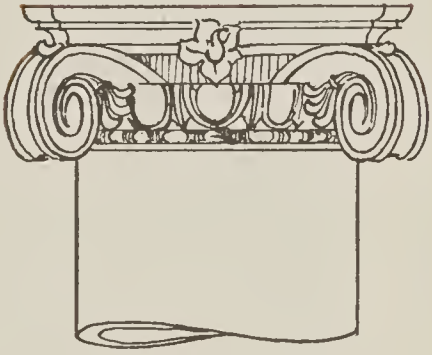
No. 10

These Columns to any desired diameter

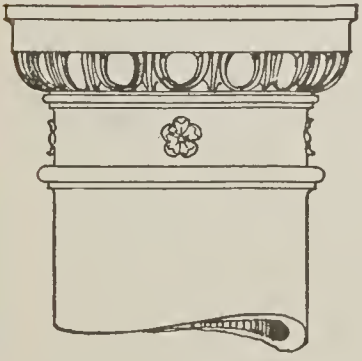
ORNAMENTAL CAPS. ROUND COLUMNS



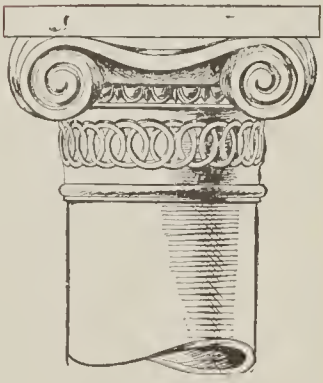
Cap No. 201



Cap No. 202

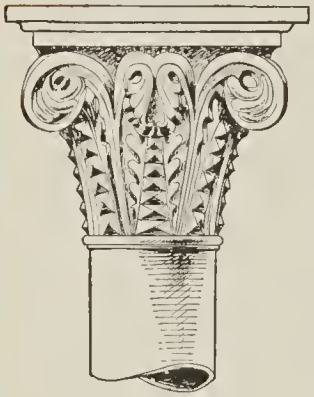


Cap No. 203

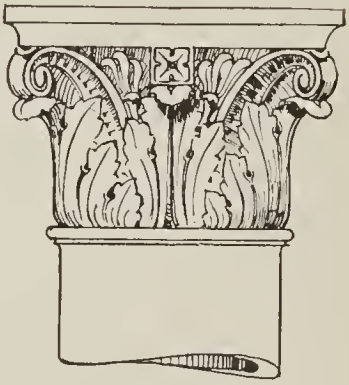


Cap No. 204

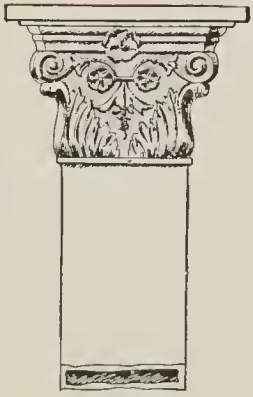
ORNAMENTAL CAPS. ROUND COLUMNS



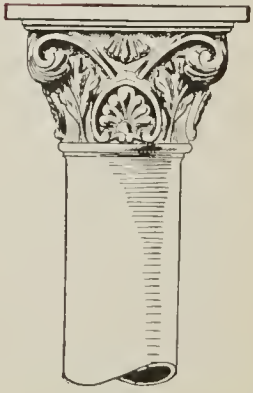
Cap No. 205



Cap No. 206

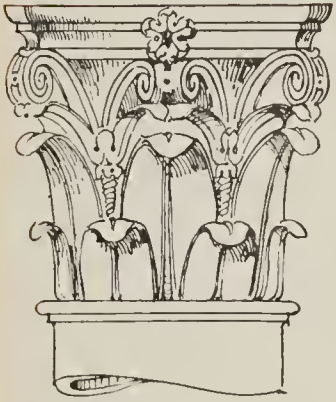


Cap No. 207

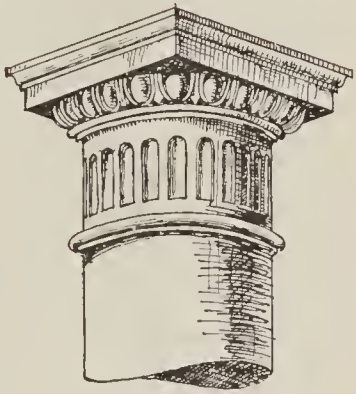


Cap No. 208

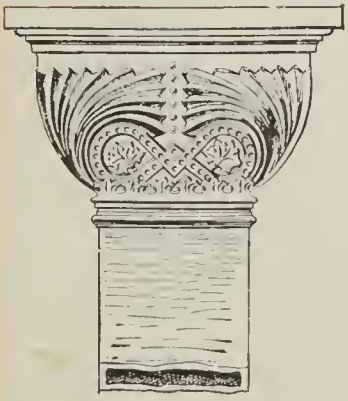
ORNAMENTAL CAPS. ROUND COLUMNS



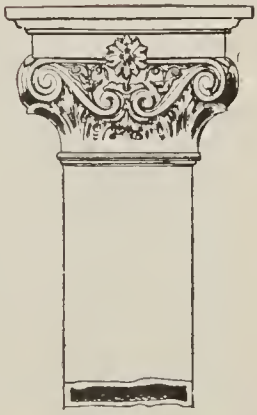
Cap No. 209



Cap No. 210

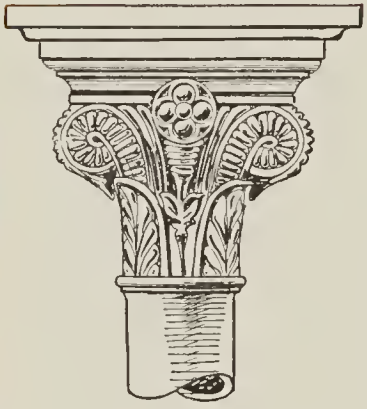


Cap No. 211

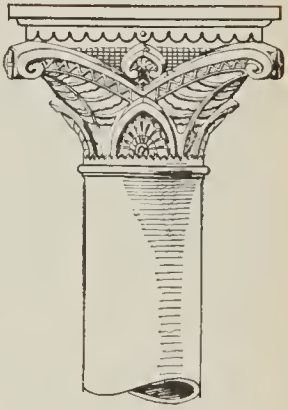


Cap No. 212

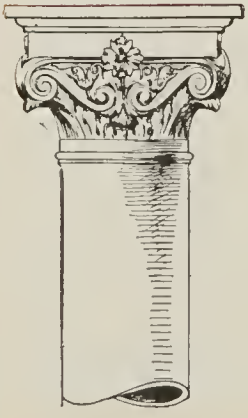
ORNAMENTAL CAPS. ROUND COLUMNS



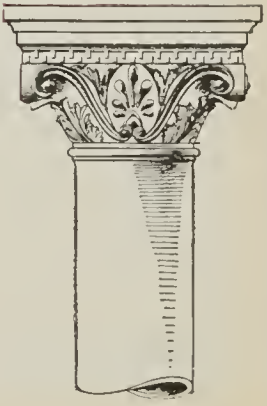
Cap No. 213



Cap No. 214

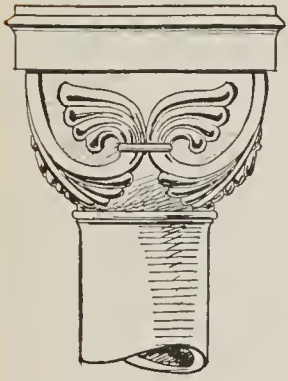


Cap No. 215

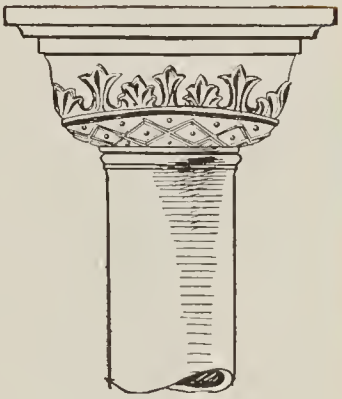


Cap No. 216

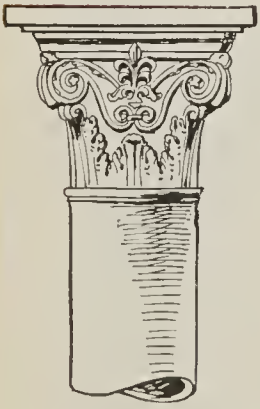
ORNAMENTAL CAPS. ROUND COLUMNS



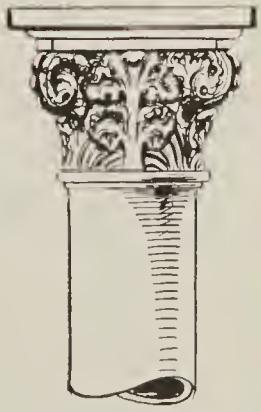
Cap No. 217



Cap No. 218



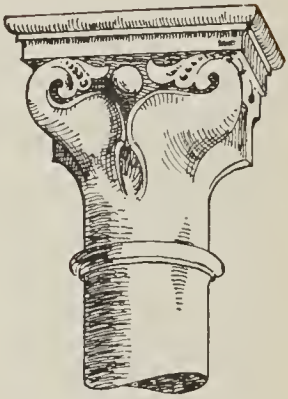
Cap No. 219



Cap No. 220

ORNAMENTAL CAPS. ROUND COLUMNS

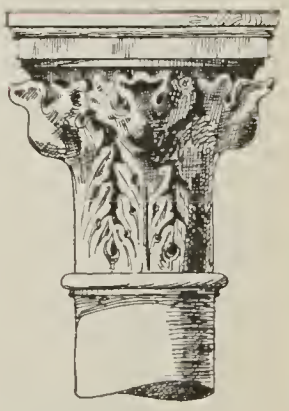
Cap No. 221.



Cap No. 222.

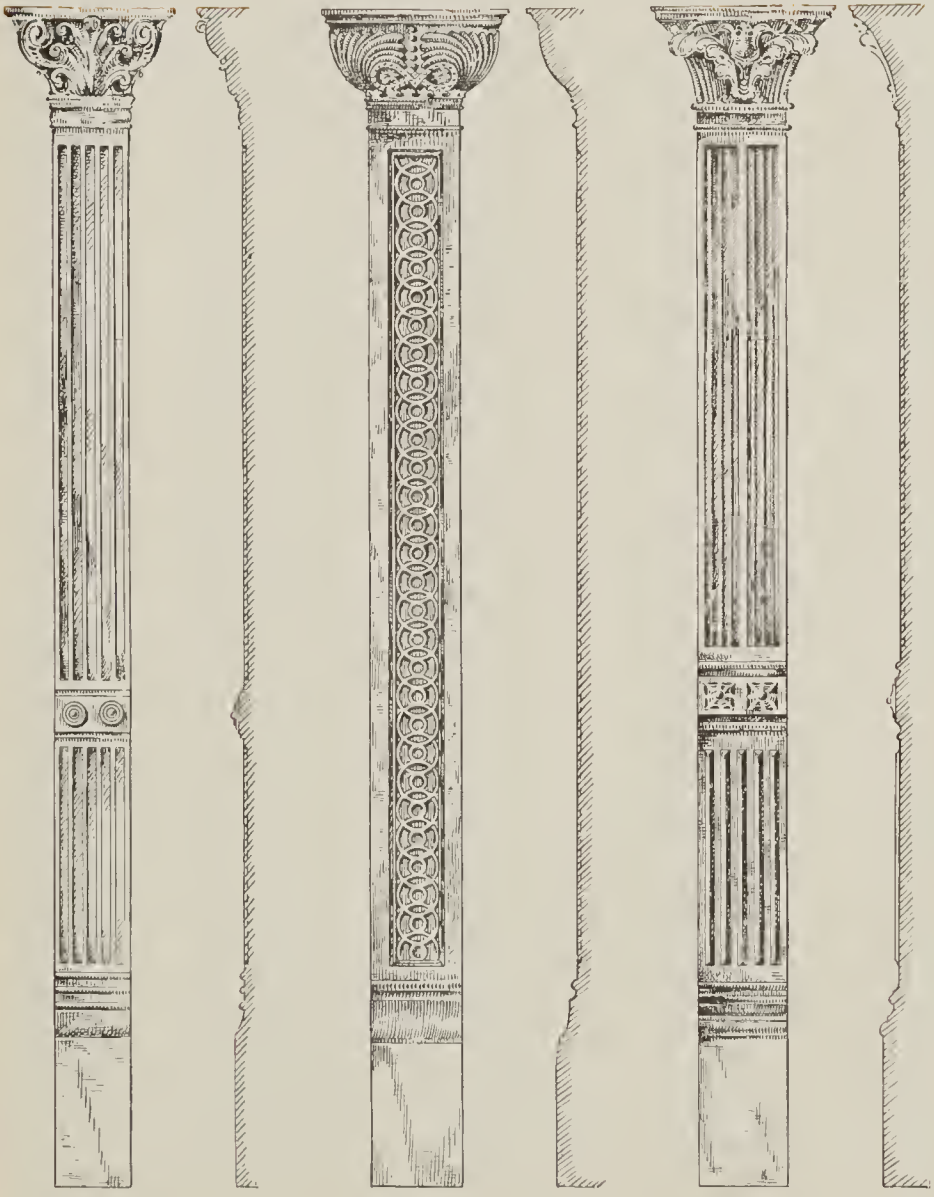
Cap No. 225.

Cap No. 223.



Cap No. 224.

SQUARE COLUMNS



Col. No. 11
10 and 11″ Face

Col. No. 12
12″ Face

Col. No. 13
12 and 13″ Face

Give thickness of metal when ordering.

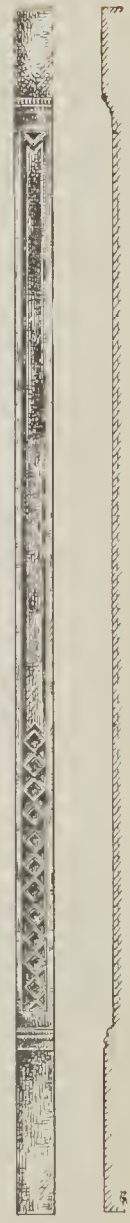
COLUMNS

Col. No. 14
5 and 6″ Face

Col. No. 15
5″ Face

Col. No. 16
6 and 7″ Face

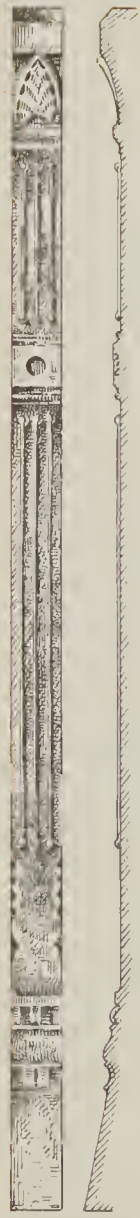
Col. No. 17
6″ Face



Col No. 18
6 and 7″ Face

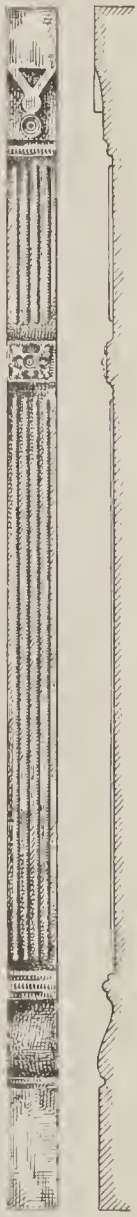
Give width of face, depth and thickness of metal when ordering.

COLUMNS

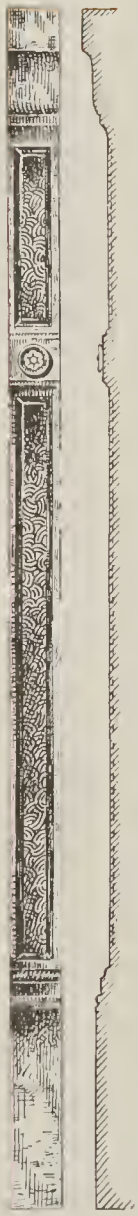


Col. No. 19
6″ Face

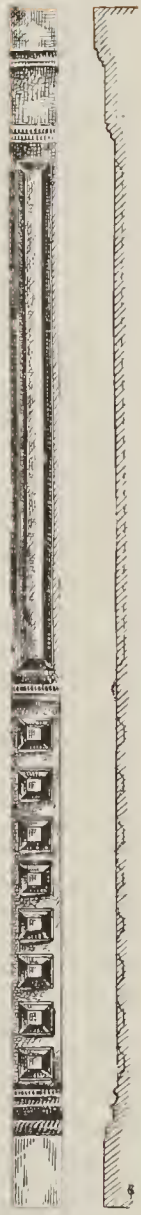
Col. No. 20
6, 7 and 7½″ Face



Col. No. 21
7 and 8″ Face



Col. No. 22
6 and 8″ Face

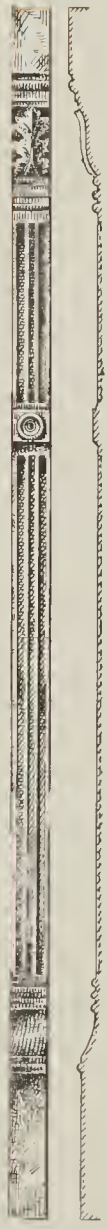


Col. No. 23
6 and 7½″ Face

Give width of face, depth and thickness of metal when ordering.

COLUMNS

Col. No. 24
8 and 9″ Face



Col. No. 25
6″ Face

Col. No. 26
6 and 7″ Face

Col. No. 27
6 and 7″ Face

Col. No. 28
6 and 8″ Face

Give width of face, depth and thickness of metal when ordering.

COLUMNS

Col. No. 29
18 and 20″ Face

Col. No. 30
18 and 30″ Face

Col. No. 31
16 and 18″ Face

Give width of face, depth and thickness of metal when ordering.

COLUMNS

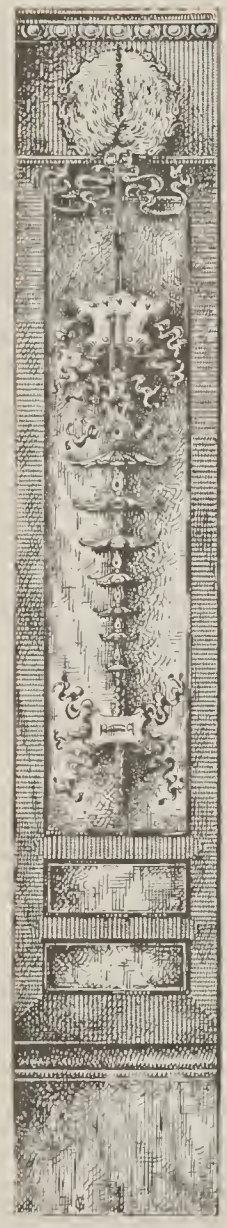
Col. No. 32
6, 8, 10 and 12″ Face

Col. No. 33
8 and 9″ Face

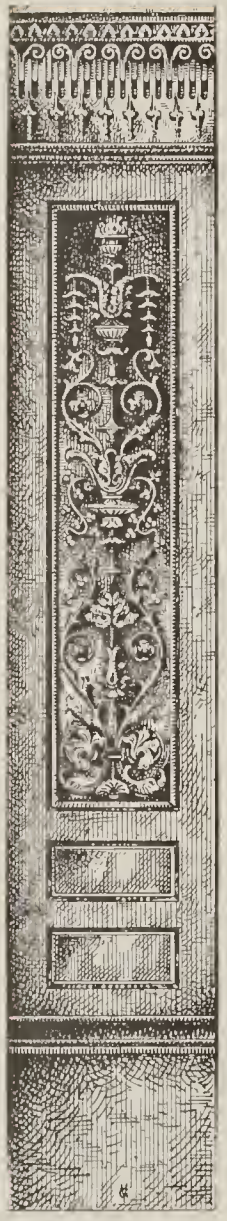
Col. No. 34
8 and 9″ Face

Give width of face, depth and thickness of metal when ordering.

PILASTERS



Col. No. 35
30″ Face

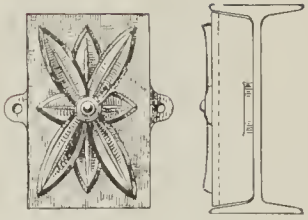


Col. No. 36
26, 28 and 30″ Face

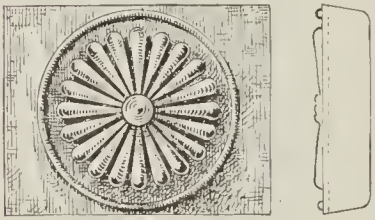
Give width of face, depth and thickness of metal when ordering.

FACE PLATES

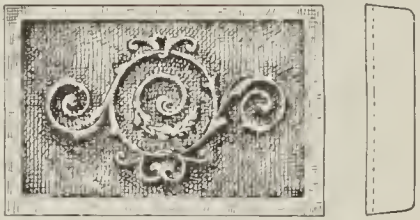
No. 301
15, 20″ I-Beam
Width 21″



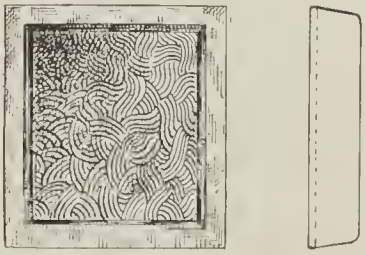
No. 302
8, 9, 10, 12″ I-Beam
Width 6 to 10″



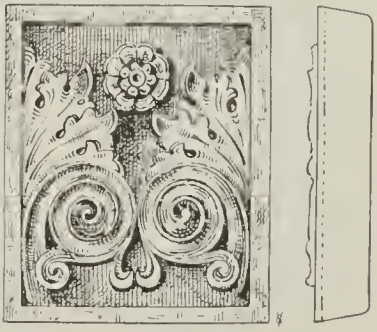
No. 303
10, 12, 15″ I-Beam
Width 10 to 15″



No. 304
12, 15″ I-Beam
Width 15 to 20″



No. 305
Any size or width



No. 306
15, 18, 20″ I-Beam
Width 8 and 12″

ENTRANCE PLATES AND SASH BARS

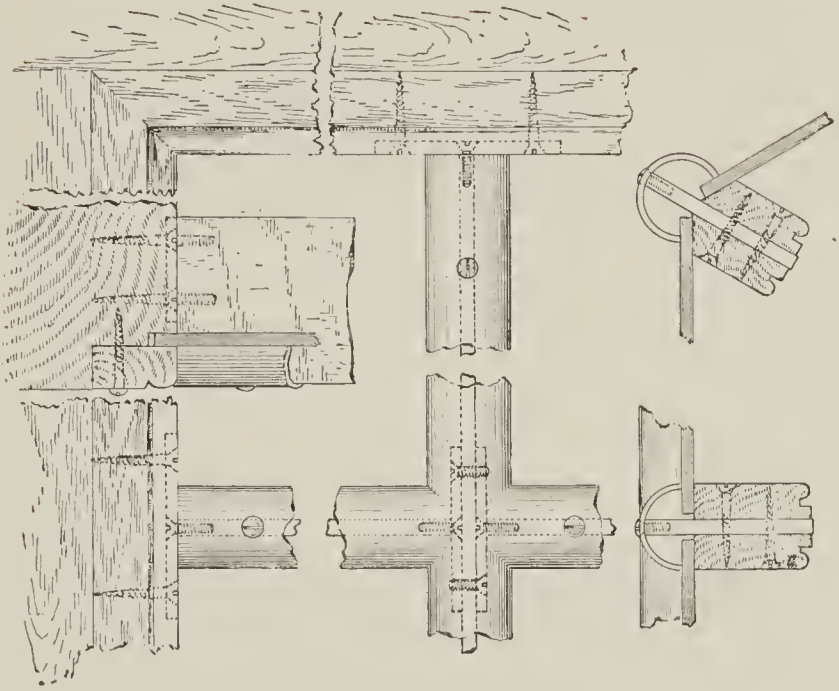


Fig. 40
Sash Bar. Plain, Nickel or Copper Finish.
Special designs to order.

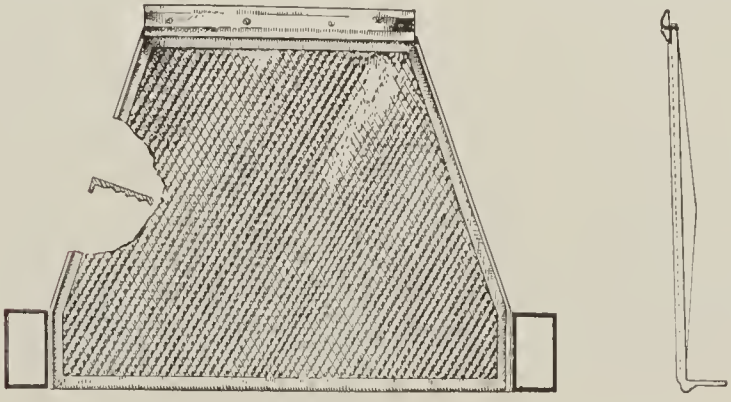
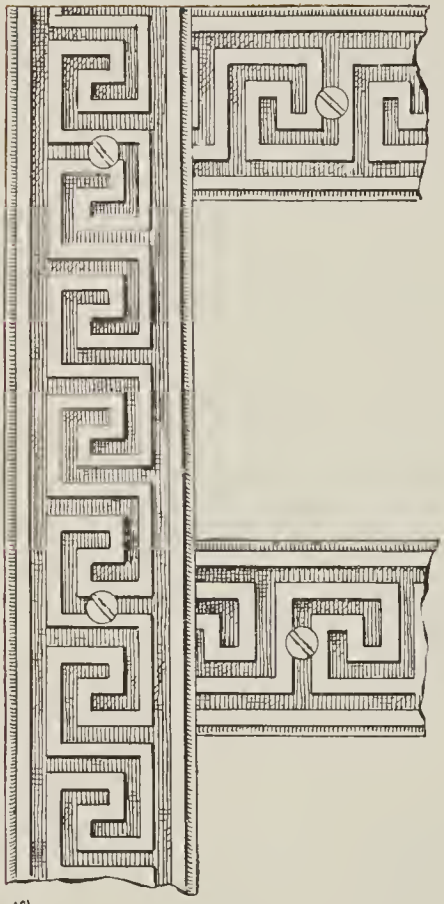
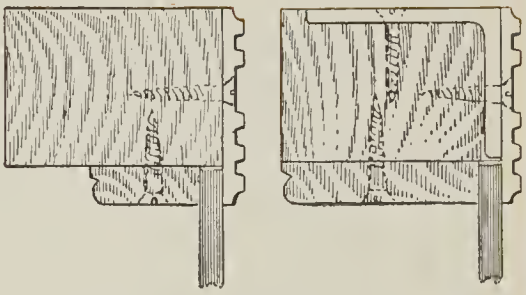


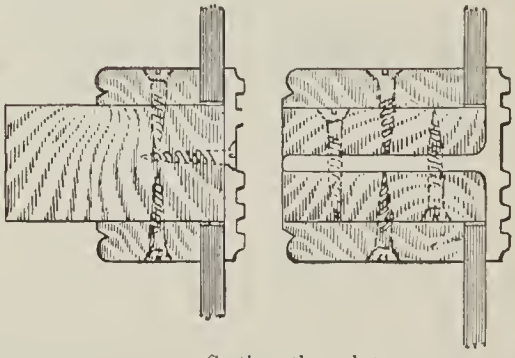
Fig. 41
Entrance Plates.

SASH BAR

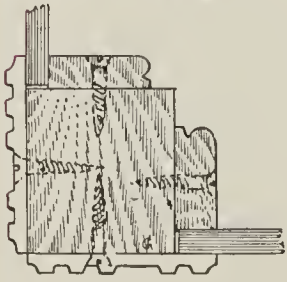


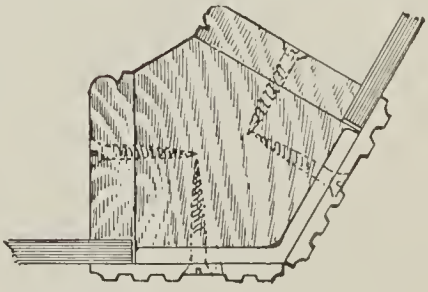


Sections through top bars.



Sections through transom bars.

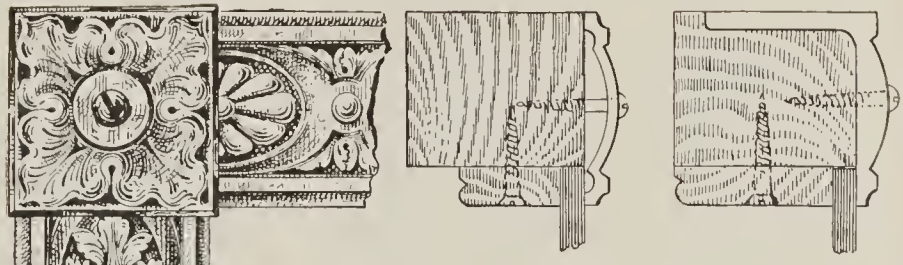




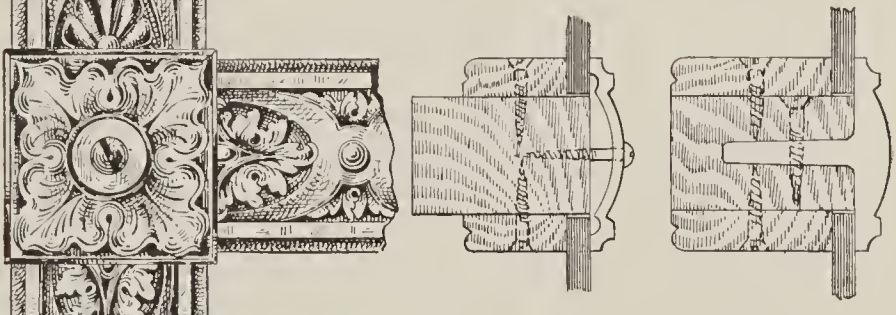
Sections through vertical bars.

Design No. 1500
$2\frac{9}{16}$″ Wide

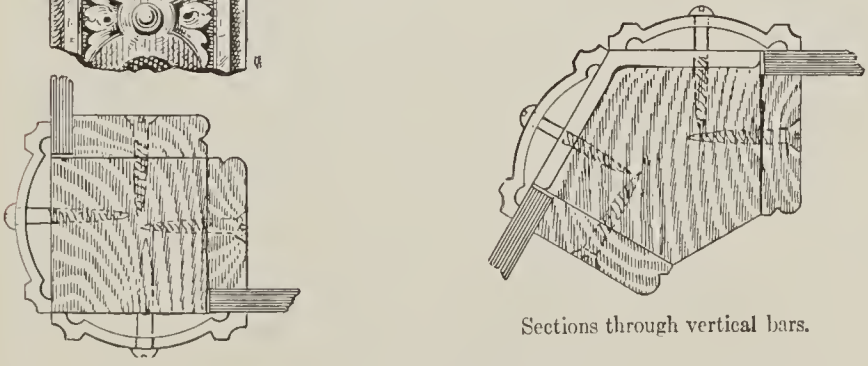
SASH BAR



Sections through top bars.



Sections through transom bars.



Sections through vertical bars.

Design No. 1482
2¼″ Wide

WINDOW SILLS AND DOOR GUARDS

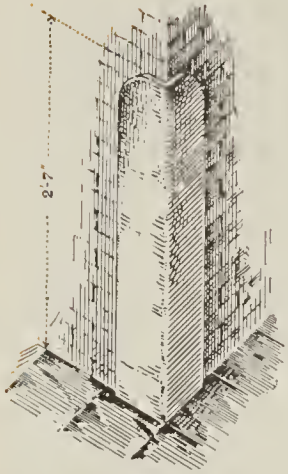


Fig. 42

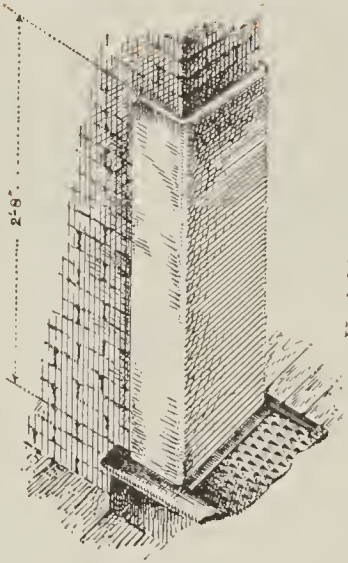


Fig. 43

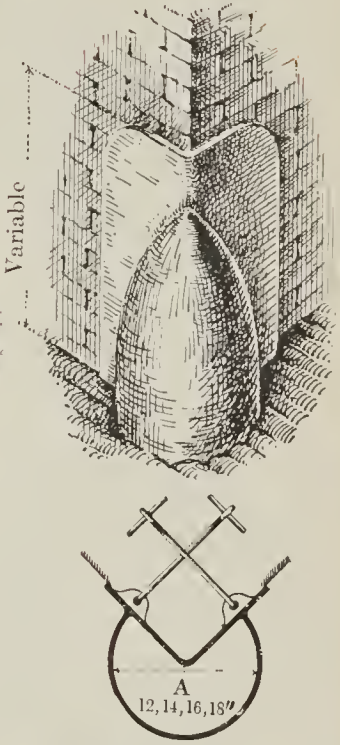


Fig. 44

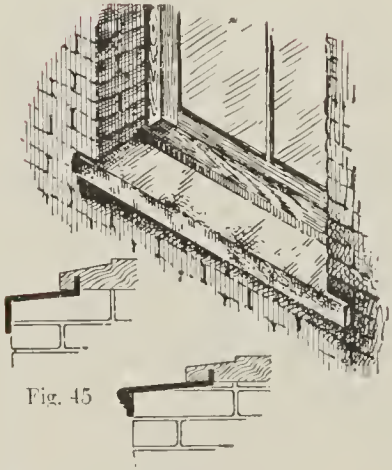


Fig. 45

Fig. 46

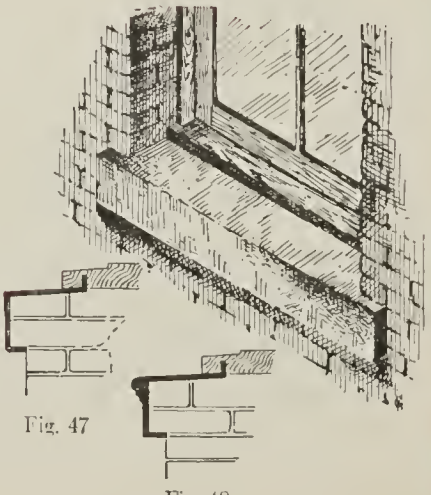


Fig. 47

Fig. 48

AREA GRATES, STIRRUPS AND JOIST ANCHORS

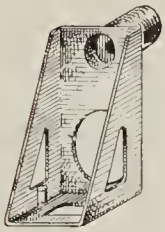


Fig. 49
Duplex Hanger

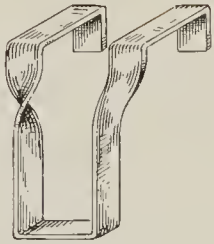


Fig. 50
Single Stirrup

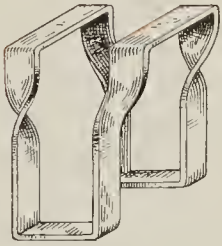


Fig. 51
Double Stirrup

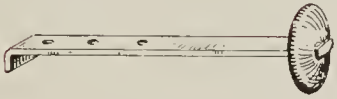


Fig. 52
Joist Anchor

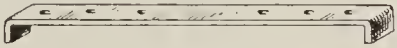


Fig. 53
Strap Anchor

Fig. 54
Vault Rod

Fig. 55
Wall Plate Bolt

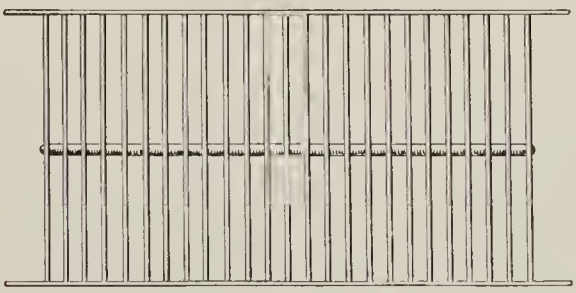
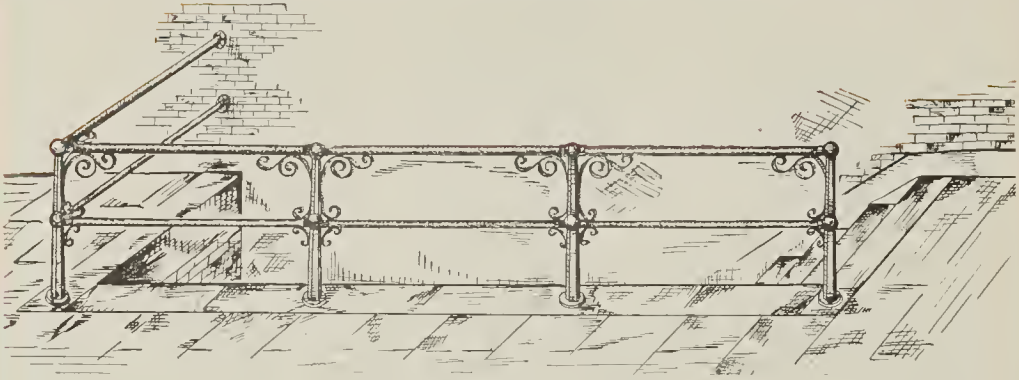


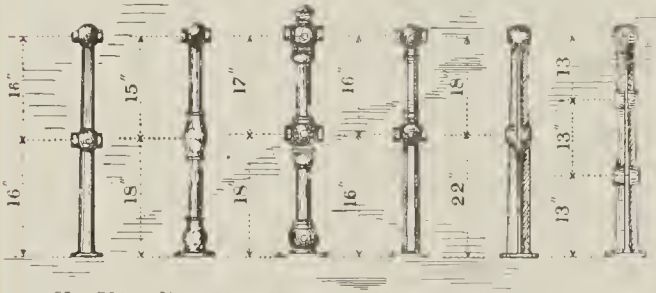
Fig. 56
Area Grate in Stone

Fig. 57. Area Grate in Wood

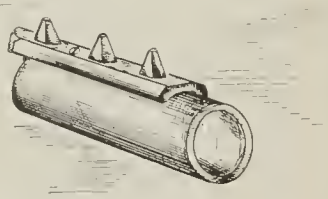
RAILINGS FOR AREA WAYS



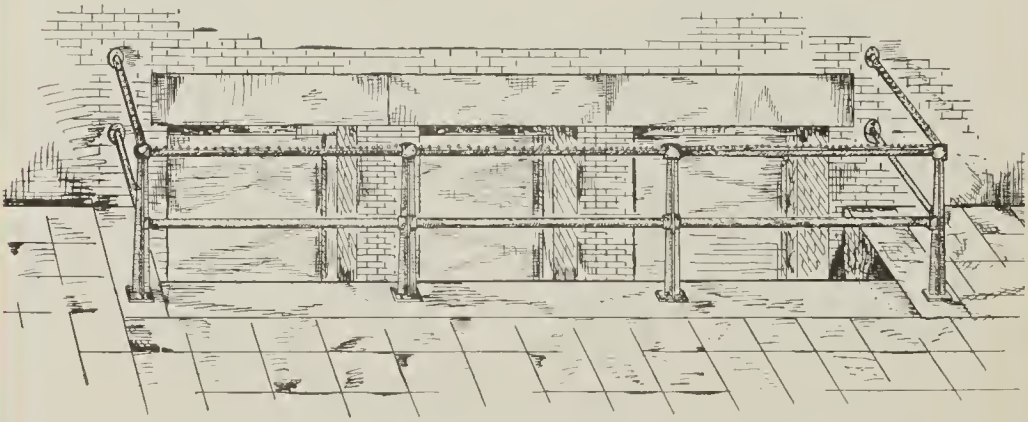
No. 507



No. 501 No. 502 No. 503 No. 504 No. 505 No. 506

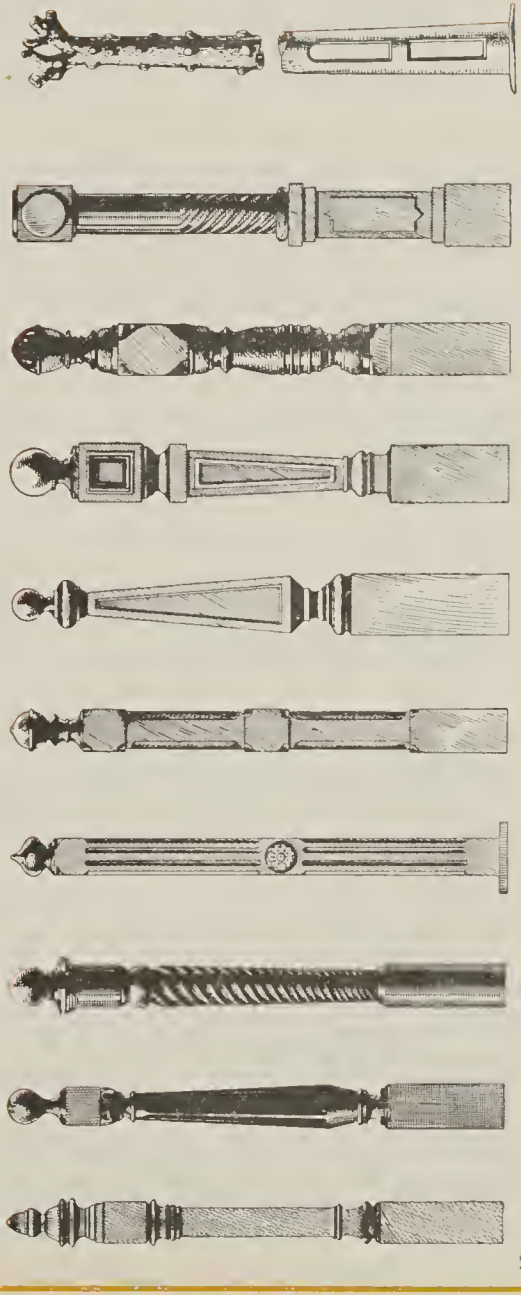


Spiked Top Rail



No. 508
Rail with Spiked Top.

NEWEL POSTS



No. 563 Hitching Post 5 to 2 1/2"

No. 562 Bridge Newel 6"

No. 561 5"

No. 560 5 1/2"

No. 559 6"

No. 558 4"

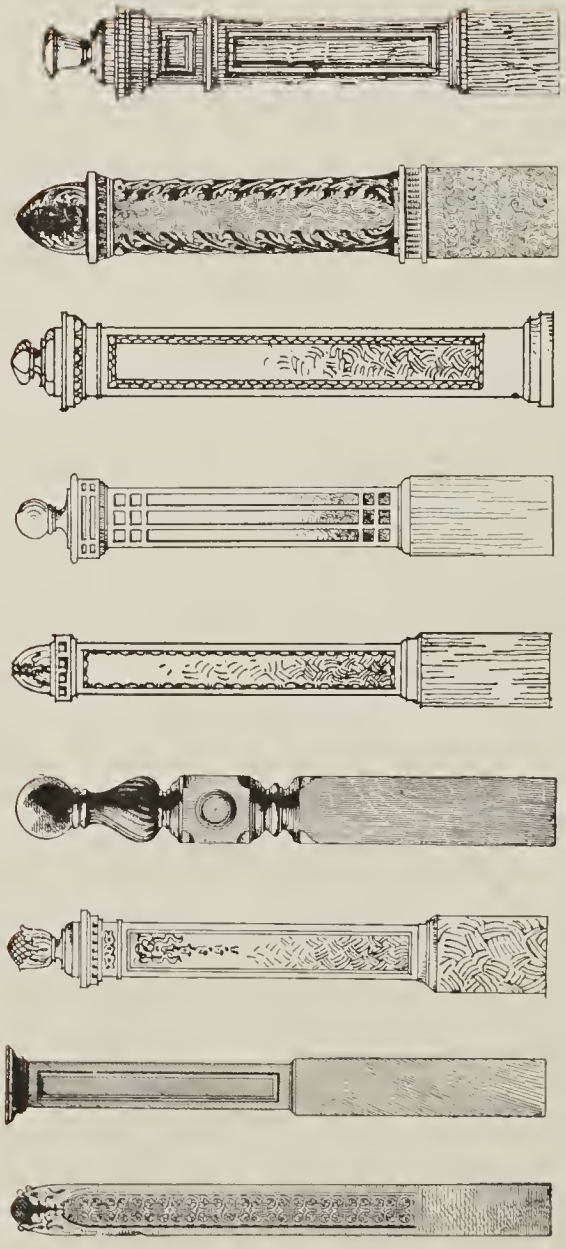
No. 557 3 1/2"

No. 556 4"

No. 555 4 1/2"

No. 554 4"

NEWEL POSTS



No. 572 8′

No. 571 8″

No. 570

No. 569

No. 568

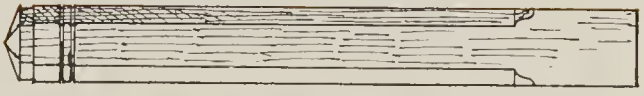
No. 567 6′

No. 566

No. 565 5″

No. 564 4½″

NEWEL POSTS

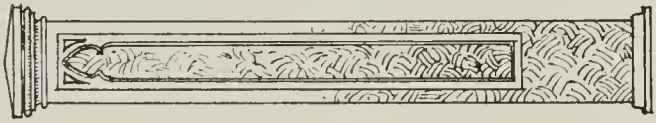


No. 579.

No. 578.

No. 577.

No. 576.



No. 575.

No. 574.

No. 573.

CAST STAIR RAIL

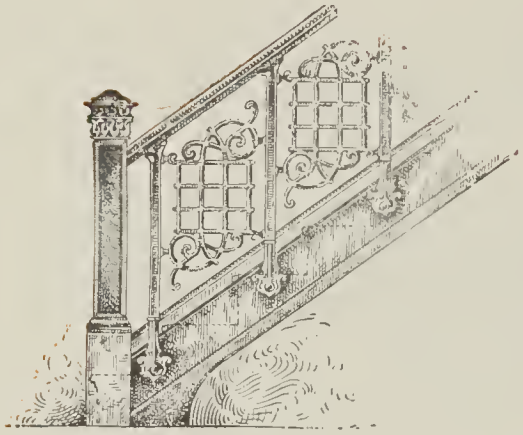


Fig. 58

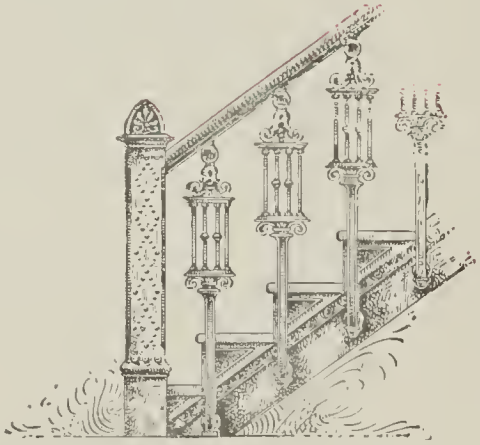


Fig. 59

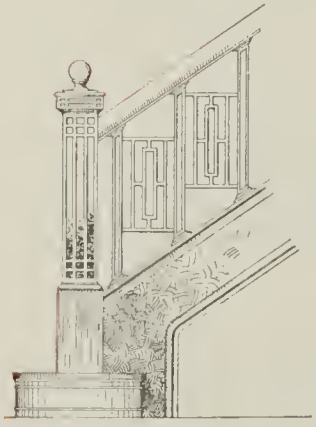


Fig. 60

CAST STAIR RAIL

Fig. 61.

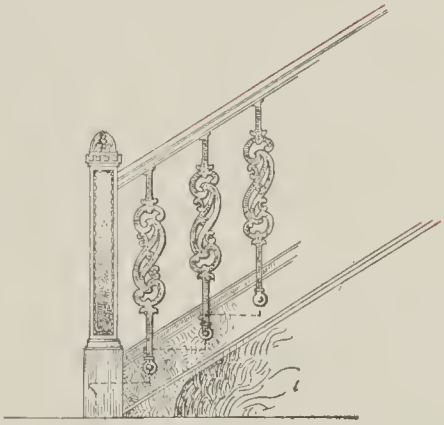


Fig. 62.

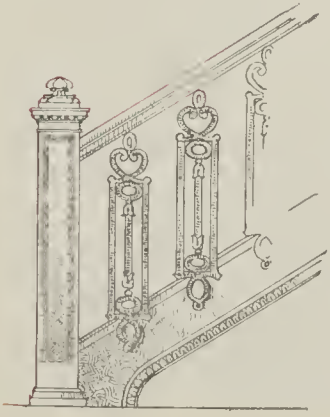


Fig. 63.

RAILS FOR ENTRANCE STEPS

Fig. 64

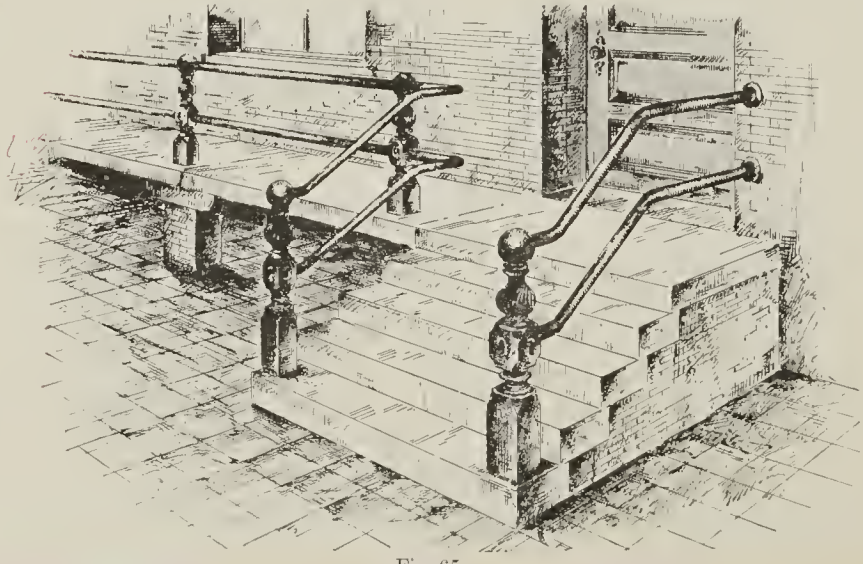


Fig. 65

OUTSIDE STAIRS

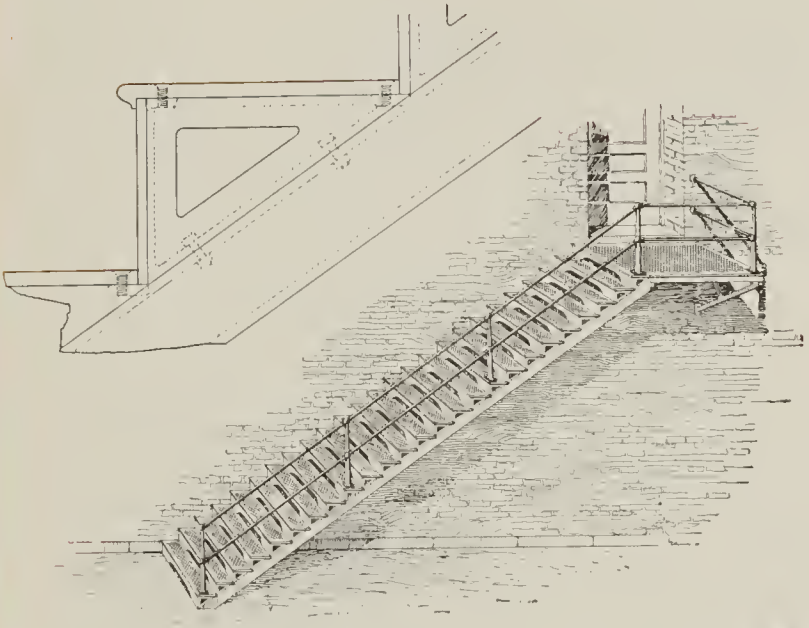


Fig. 66.

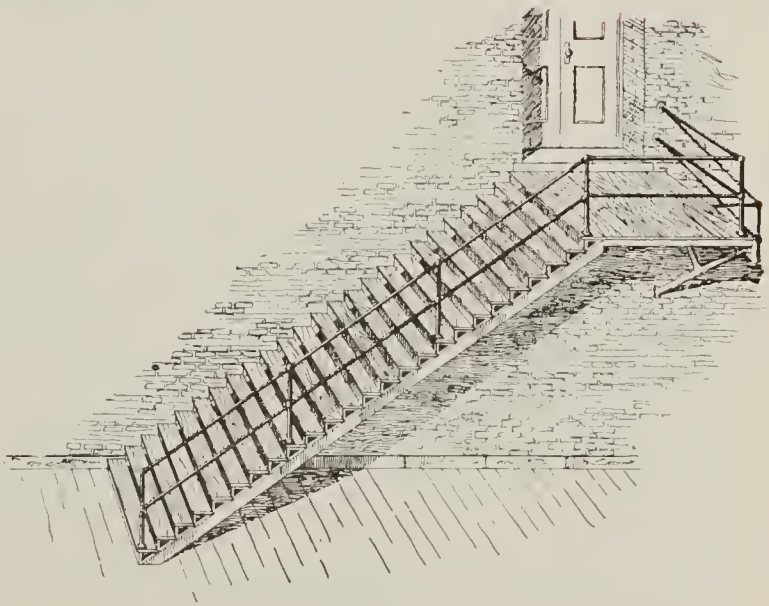
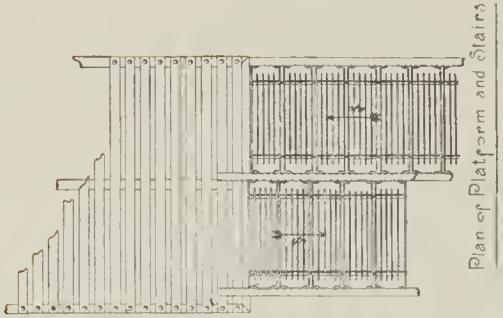


Fig. 67.

FIRE ESCAPE



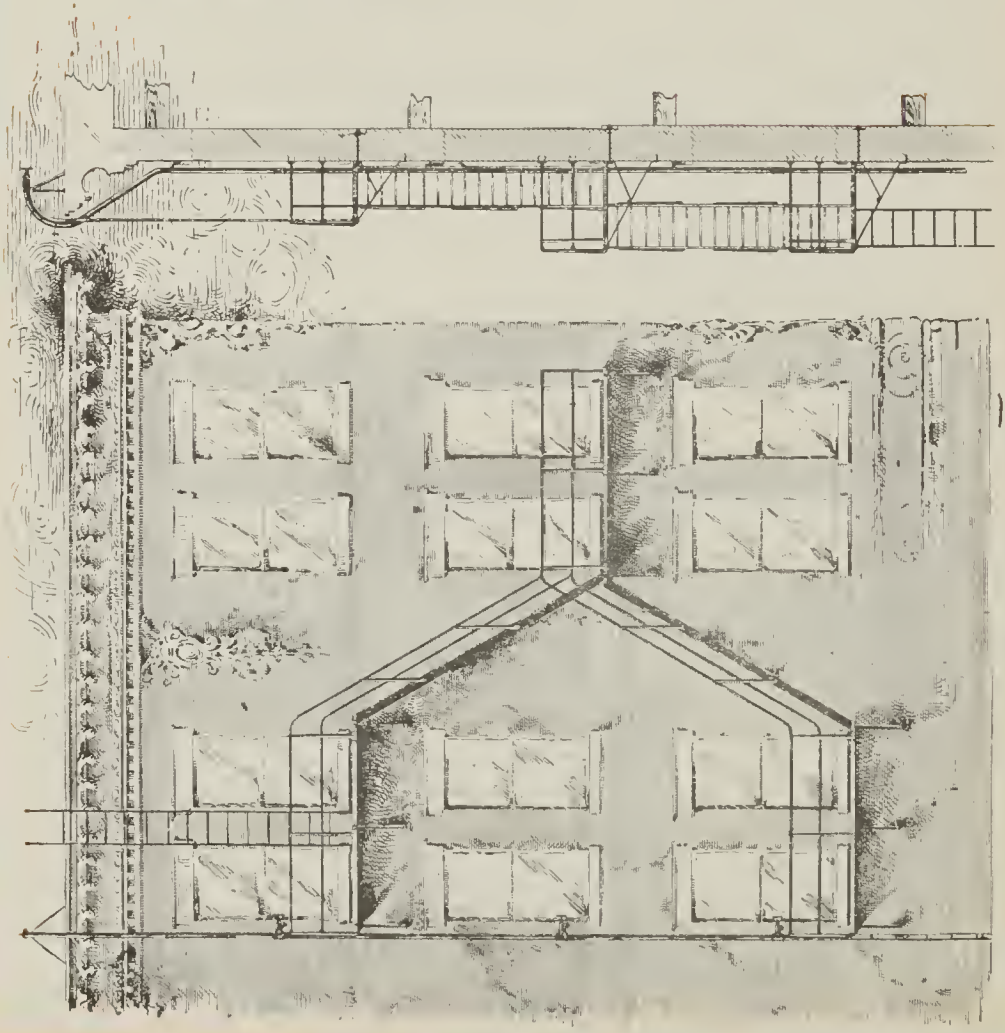
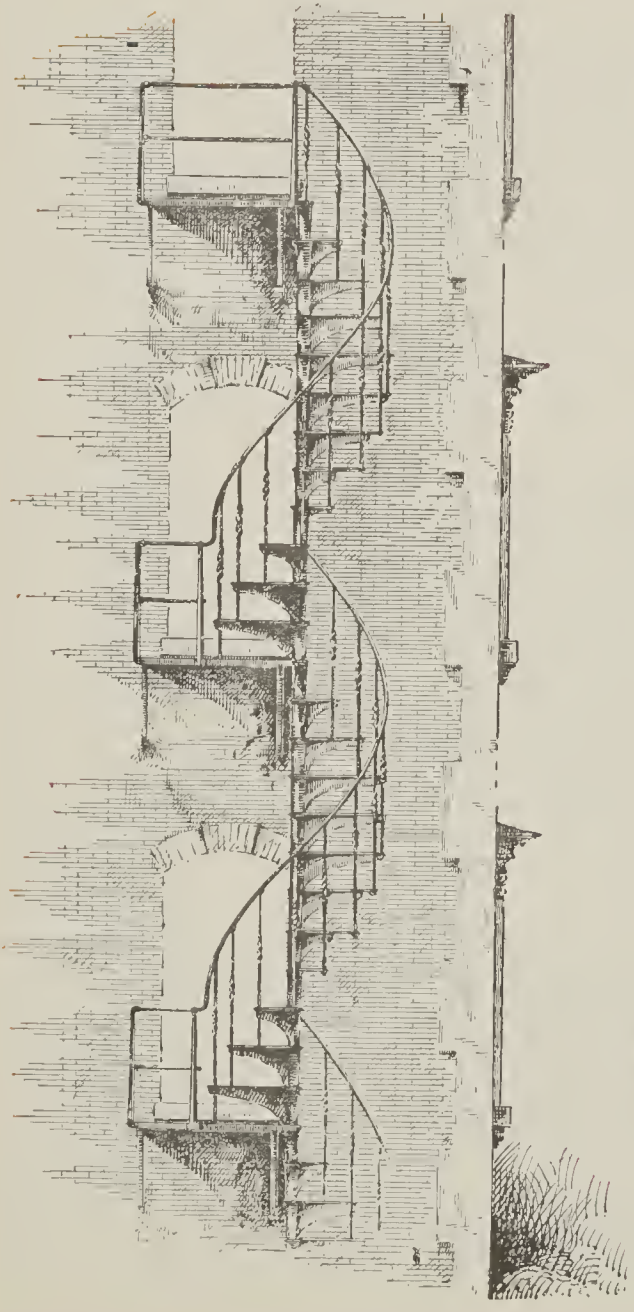
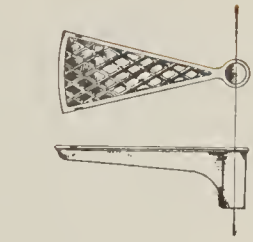


Fig. 68

CIRCULAR FIRE ESCAPE





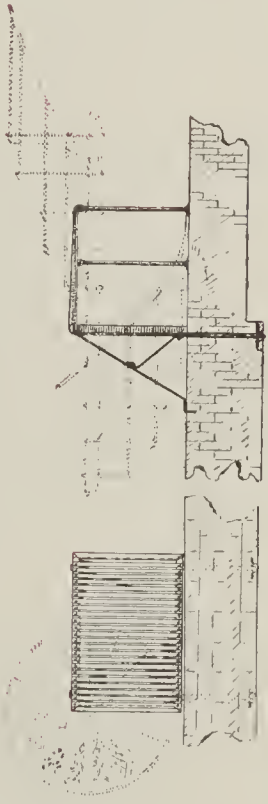


Fig. 69

BALCONY RAILS

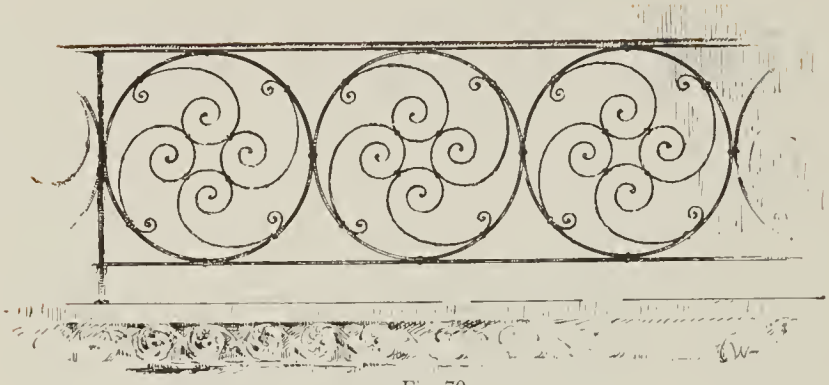


Fig. 70

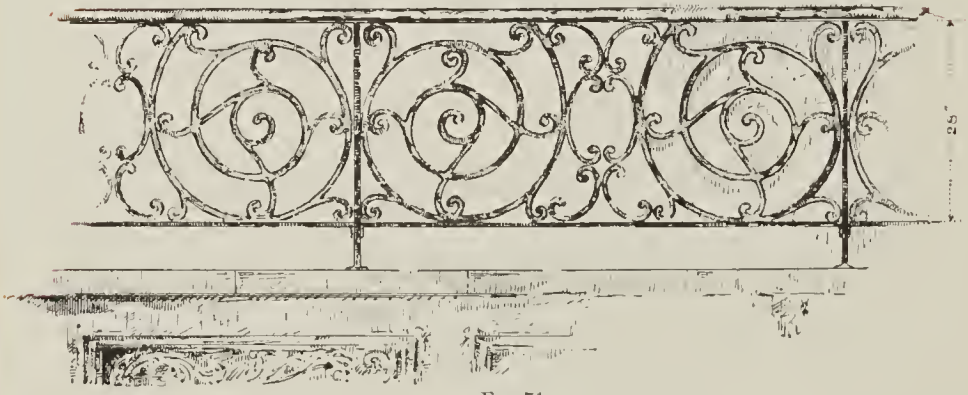


Fig. 71

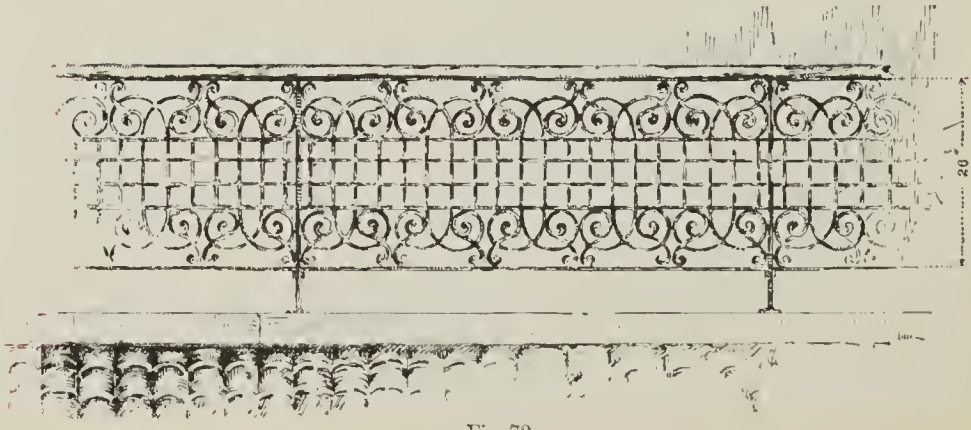


Fig. 72

BALCONY RAILS

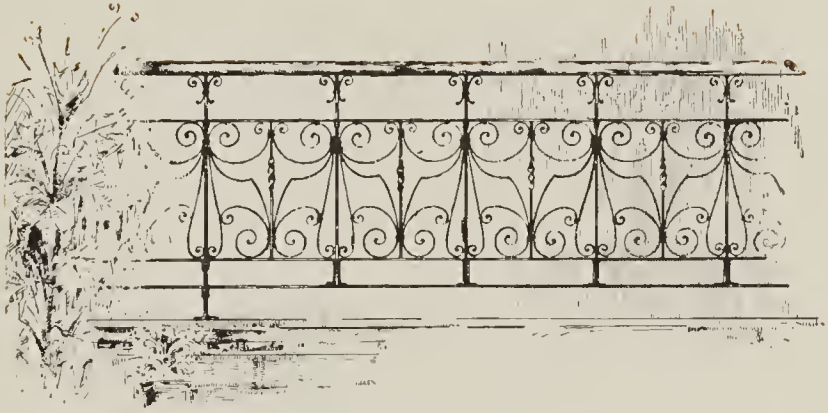


Fig. 73

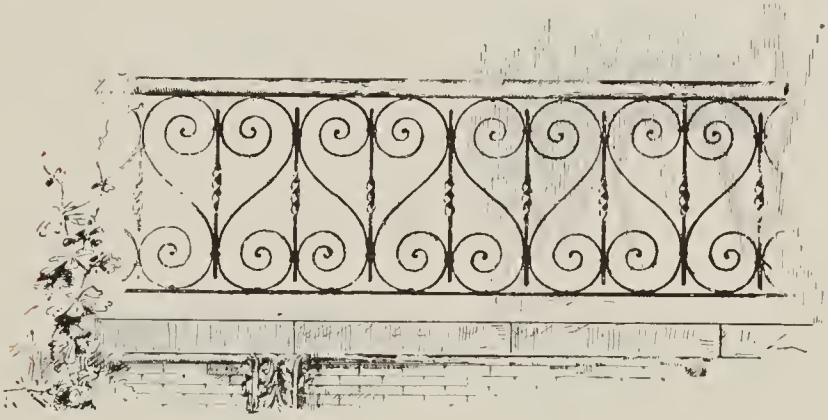


Fig. 74

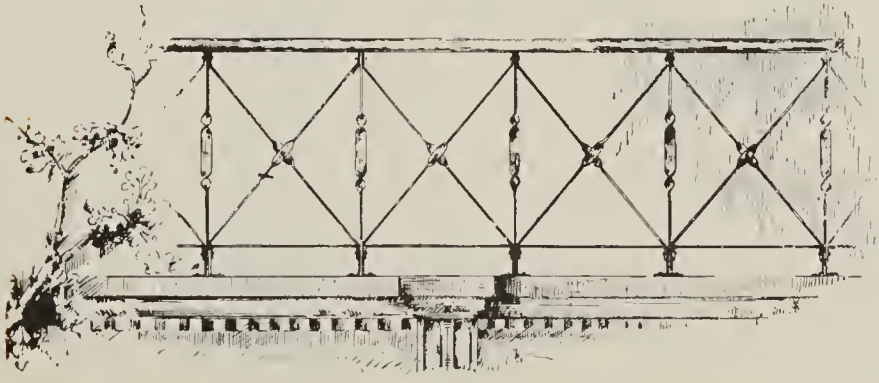


Fig. 75

WROUGHT IRON BRACKETS

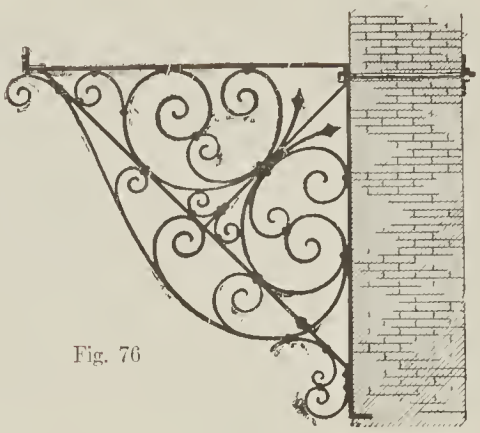


Fig. 76

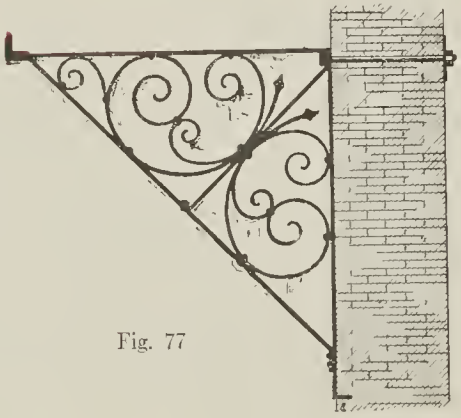


Fig. 77

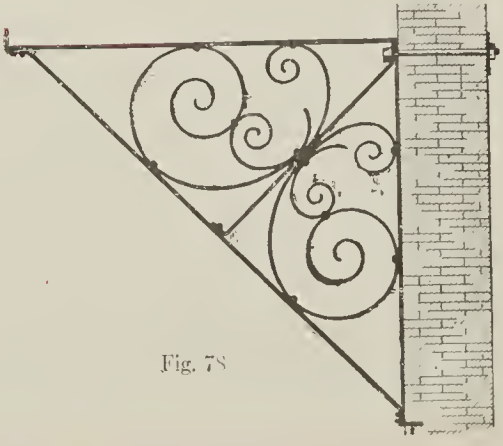


Fig. 78

ORNAMENTAL WINDOW GUARDS

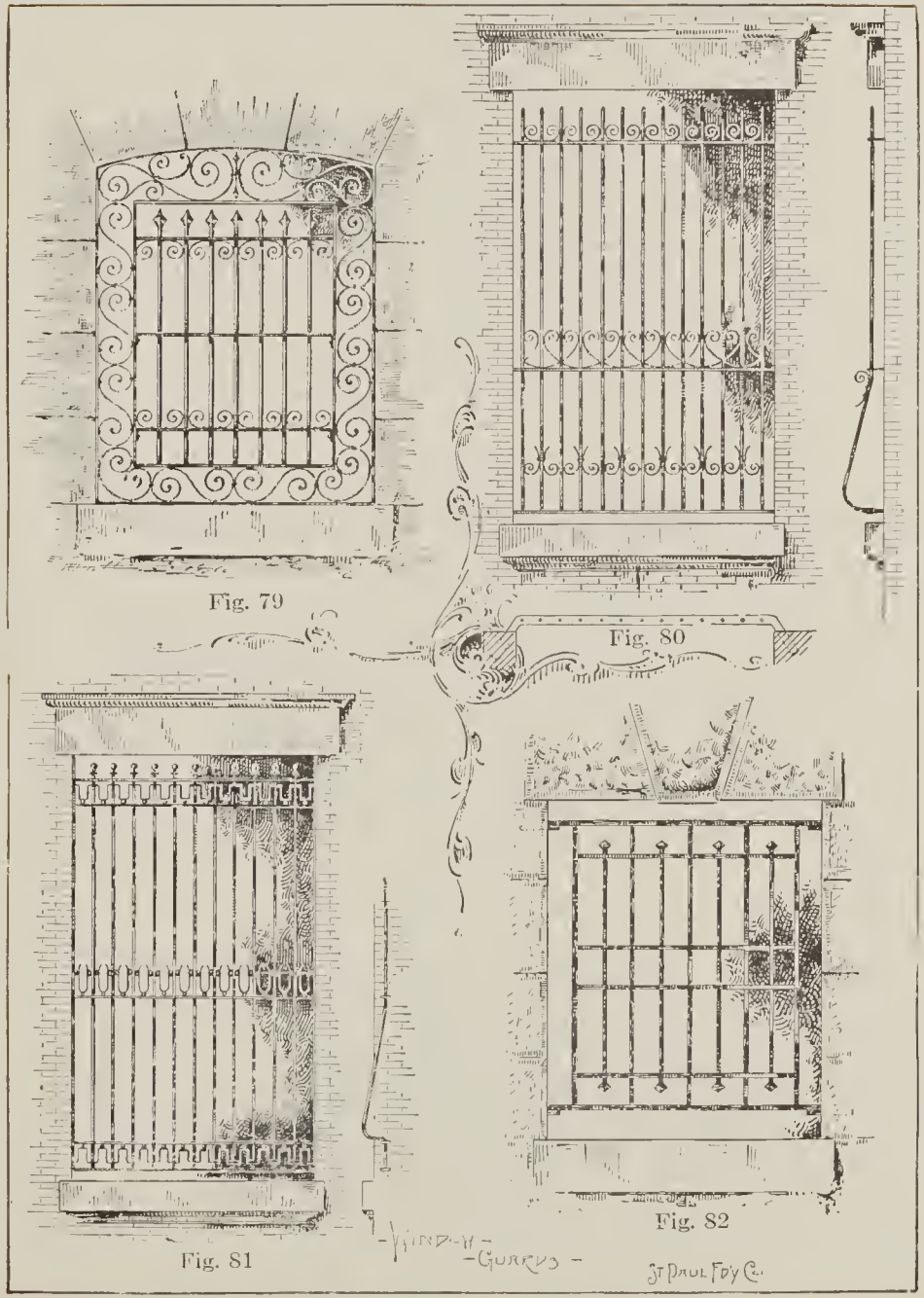


Fig. 79

Fig. 80

Fig. 81

Fig. 82

FENCE, DOOR BUMPERS, ETC.

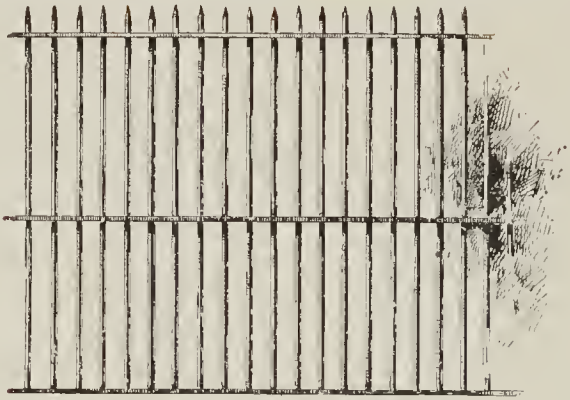


Fig. 83

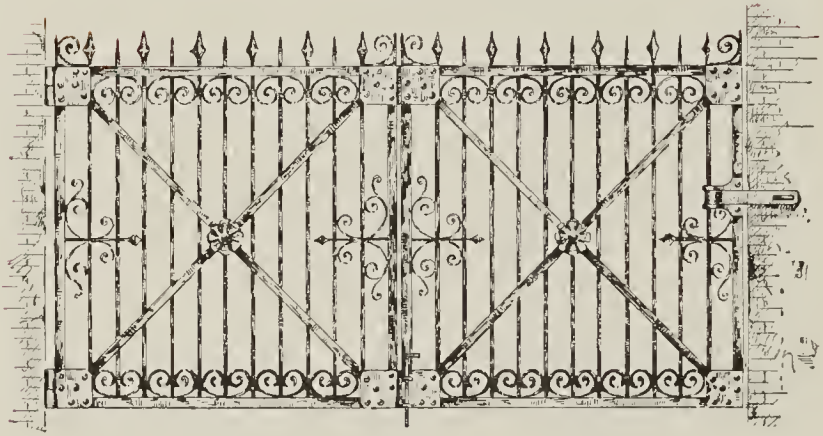


Fig. 84

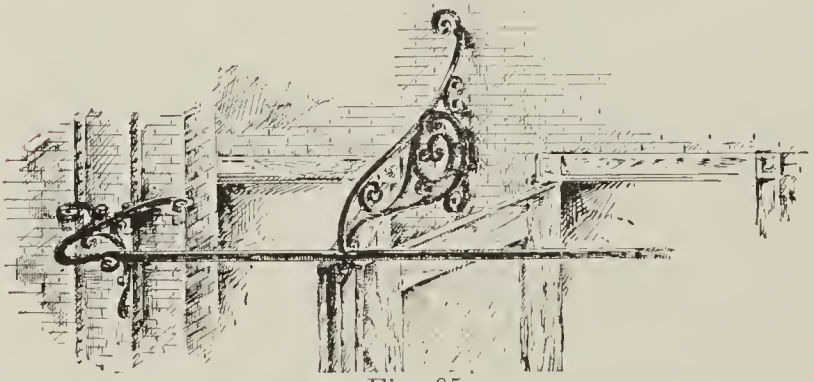


Fig. 85

Wrought Iron Door Bumper, for Railway Stations, Hotels, Etc.

ORNAMENTAL WROUGHT IRON FENCE

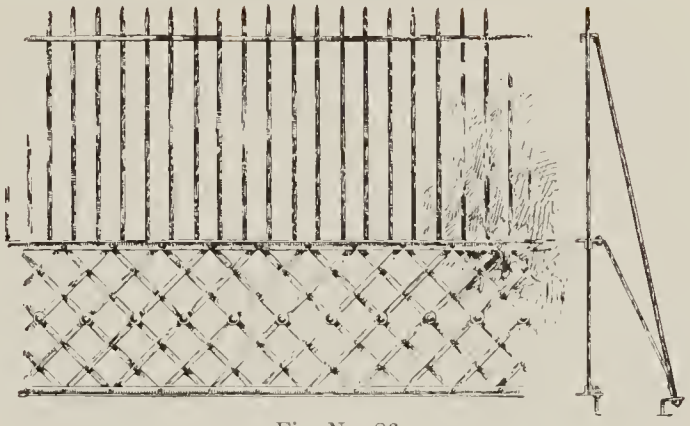


Fig. No. 86

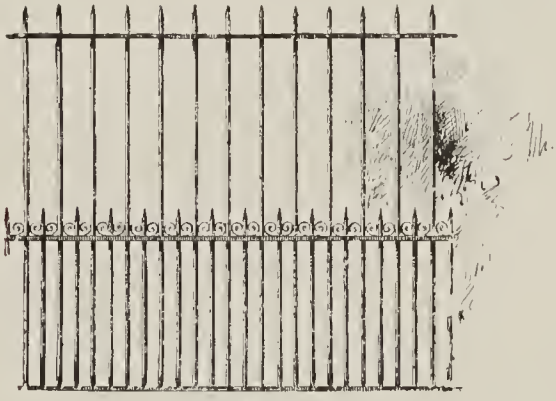


Fig. No. 87

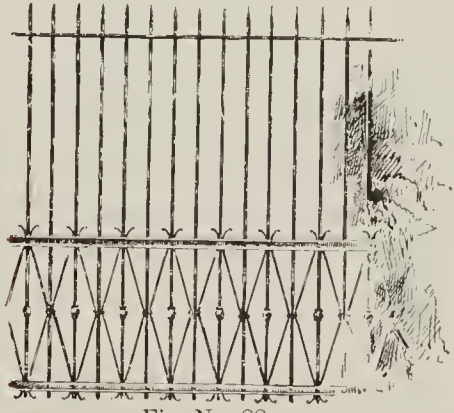
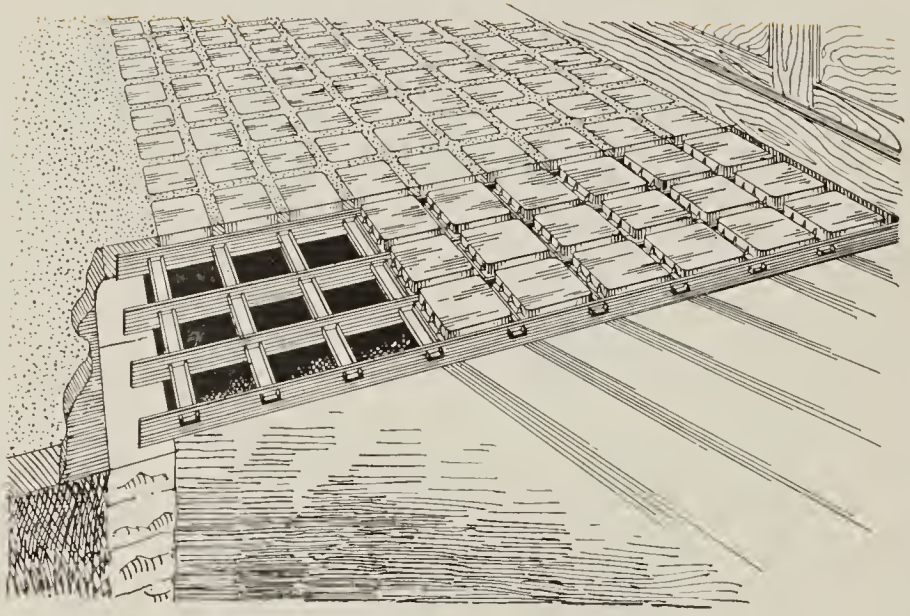
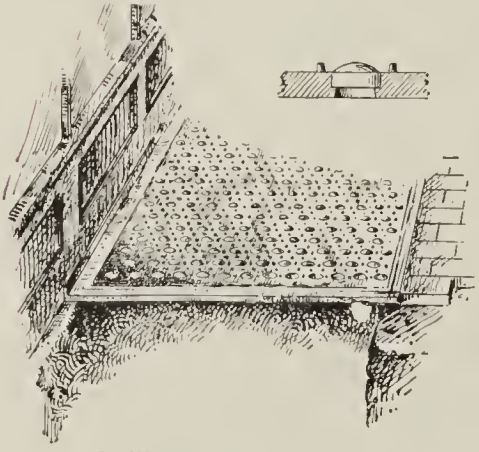


Fig. No. 88

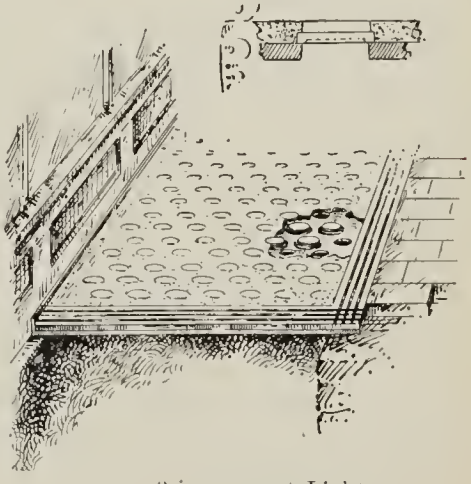
SIDEWALK LIGHTS



Bar Lock Light
Fig. 89



Bull's-eye Light
Fig. 90



3 in. cement Light
Fig. 91

Detailed information and prices on application.

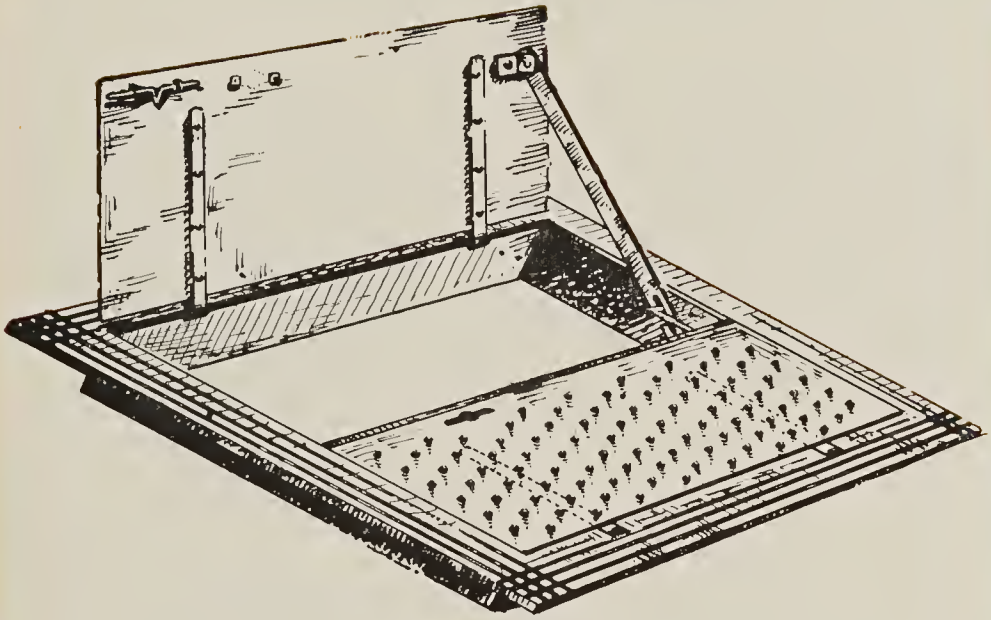


Fig. 92. Sidewalk Door.

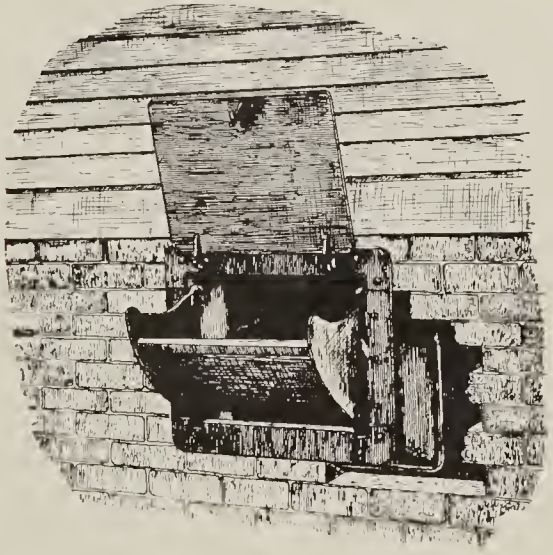
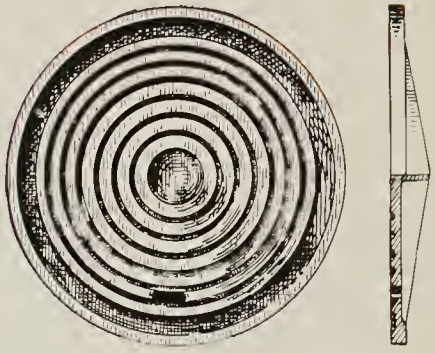


Fig. 93. Majestic Coal Chute.

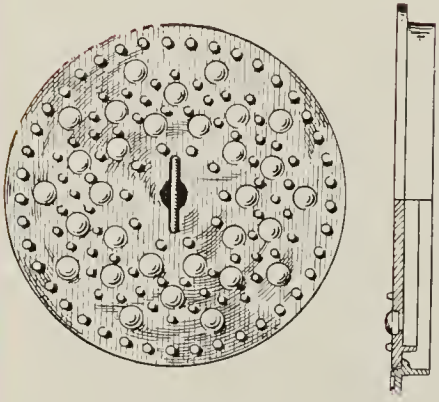
SIZES.	22 in.	wide x	16 in.	high.	Weight	100	lbs.
	27 in.	" x	16 "	"	"	125	"
	32 in.	" x	22 "	"	"	200	"

COAL CHUTES AND COVERS

Coal Hole Cover
No. 400. 20″ diameter



Cistern Cover
No. 401. 21″ diameter



Coal Hole Cover
With Bull's-eye Lights
No. 402. 21″ diameter

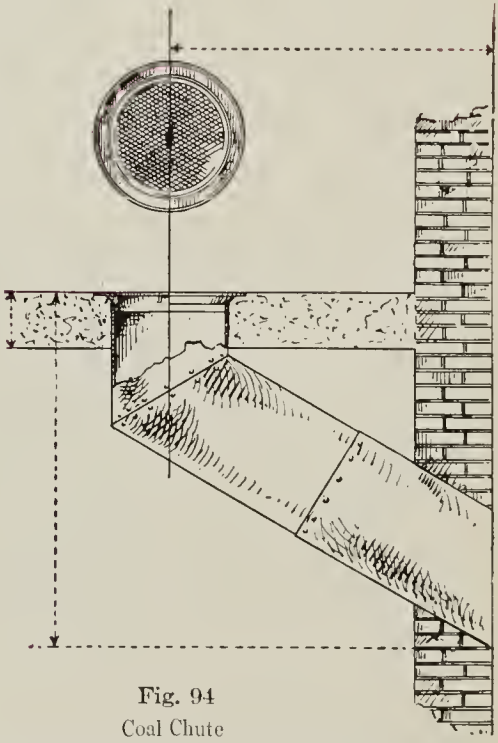
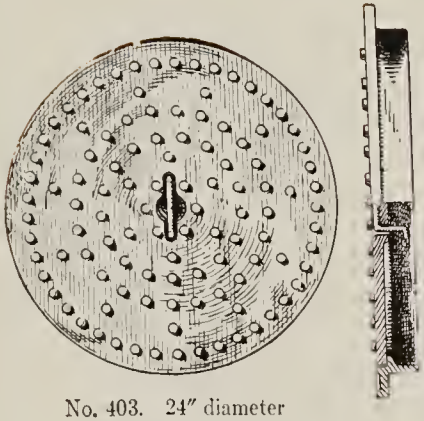
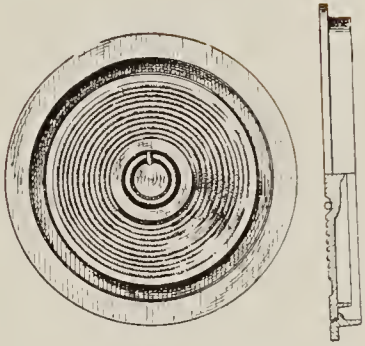


Fig. 94
Coal Chute
When ordering give dimensions shown.
Chutes to any diameter, round or square.

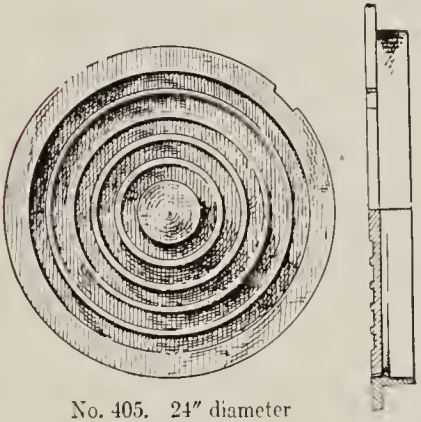
COAL HOLE COVERS



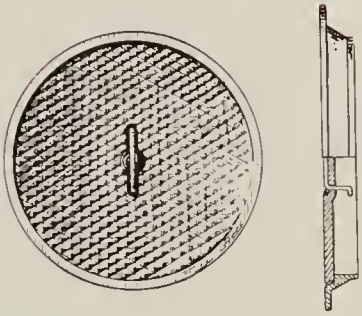
No. 403. 24″ diameter
Studded Top



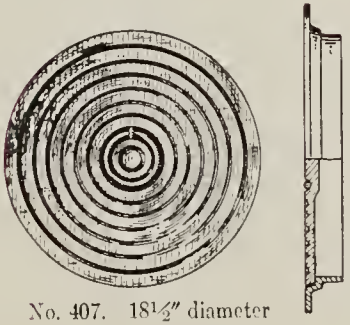
No. 404. 21″ diameter
Grooved Top



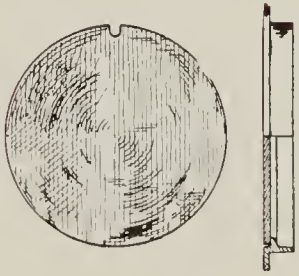
No. 405. 24″ diameter
Grooved Top



No. 406. 18½″ diameter
Diamond Point Top

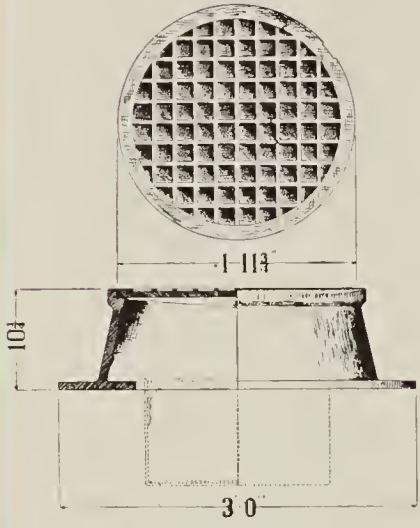


No. 407. 18½″ diameter
Grooved Top

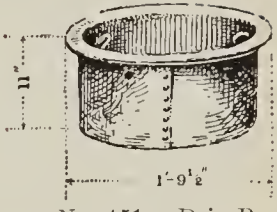


No. 408. 16″ diameter
Plain

MANHOLE FRAMES AND COVERS

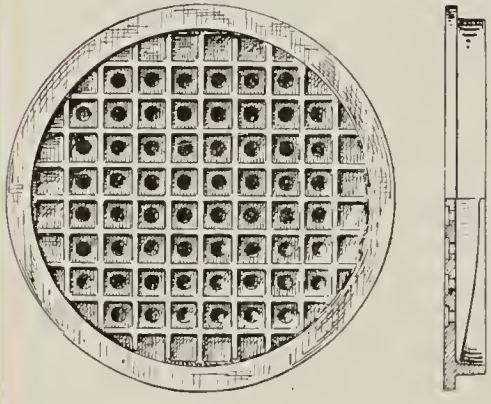


No. 450
Manhole Frame and Cover, showing drip pan

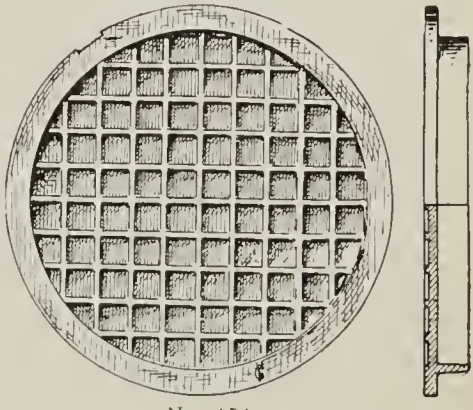


No. 451. Drip Pan

No. 452. Hinged Trap

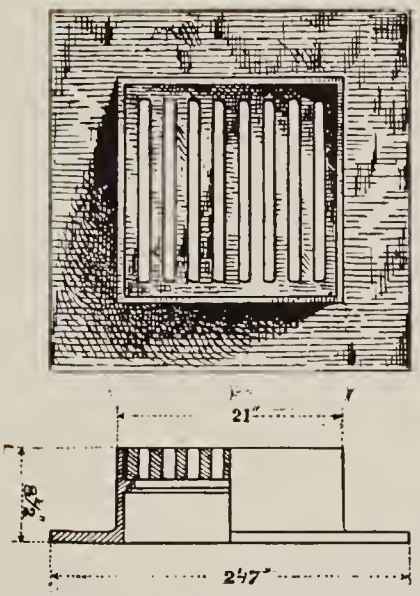


No. 453
Manhole Cover. 24" diameter

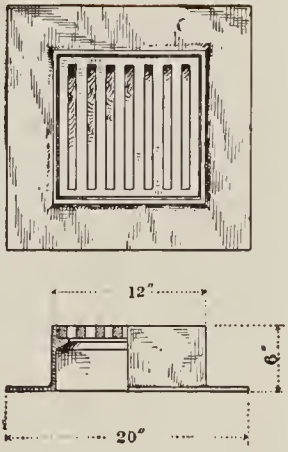


No. 454
Manhole Cover. 24" diameter

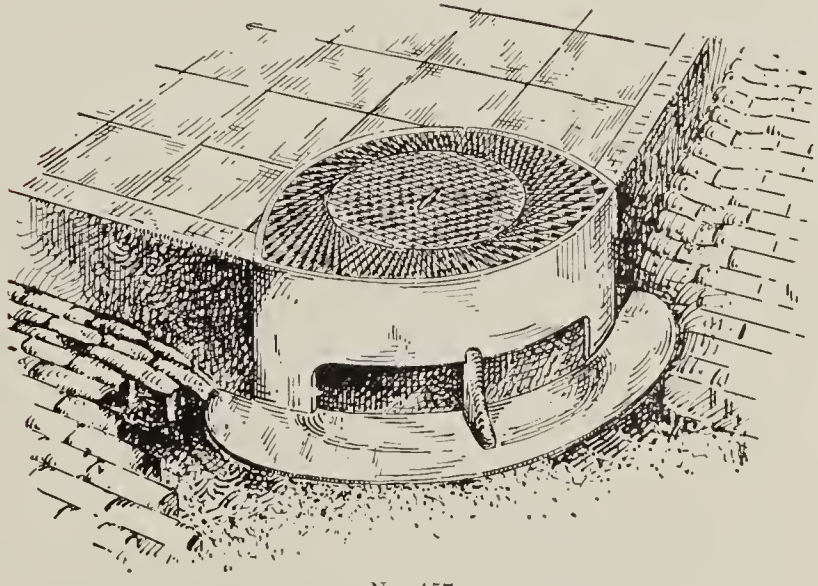
SEWER CASTINGS



No. 470. Sewer Grate and Frame
Draining of street gutters into sewer

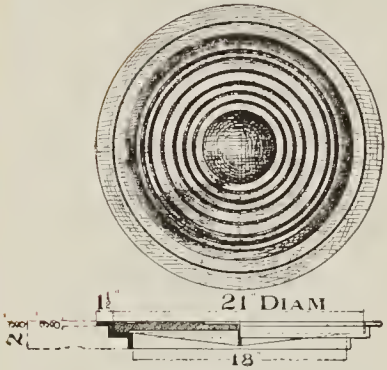


No. 471.
Sewer Grate and Frame. For drainage of street gutters into sewer.

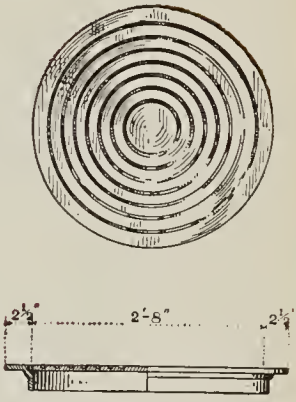


No. 457
Corner Catch Basin. Cover 20" diameter

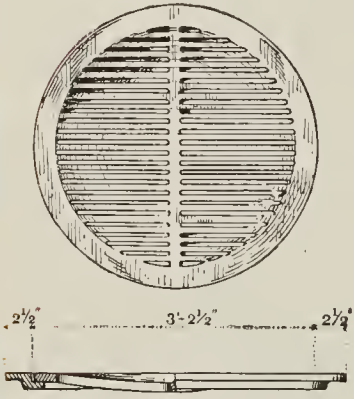
SIDEWALK COVERS WITH FRAMES. CATCH BASINS



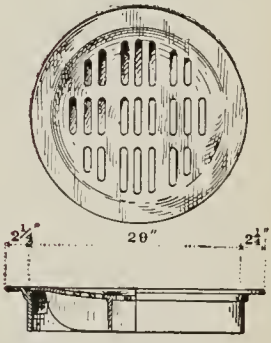
No. 461.
City Standard No. 1
For use in concrete corner stone.



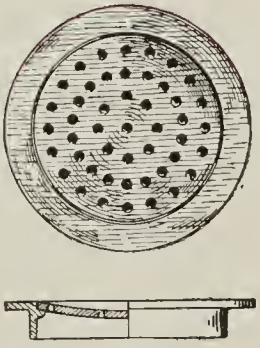
No. 462
Light Sidewalk Cover.



No. 463
Light Ventilated Cover



No. 464
Heavy Street Cover



No. 465
Catch Basin, Frame and Cover.

Frame, 14″ diameter.		Cover, 12″ diameter.	
" 24″	"	" 20″	"
" 30″	"	" 24″	"
" 36″	"	" 30″	"

MISCELLANEOUS CASTINGS

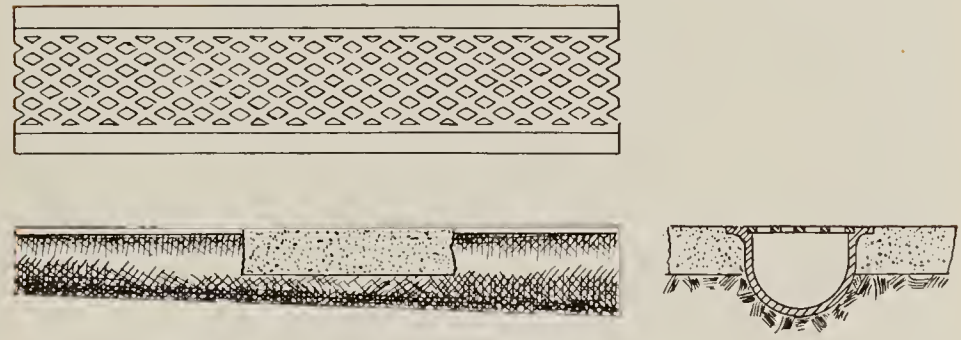


Fig. 95. Graded Gutter.

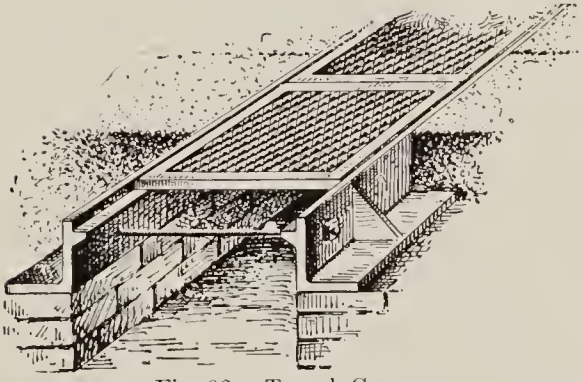


Fig. 96. Trench Cover.

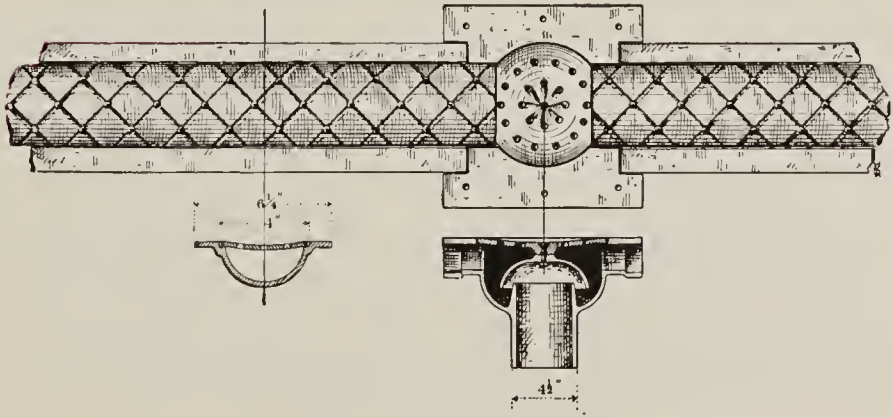
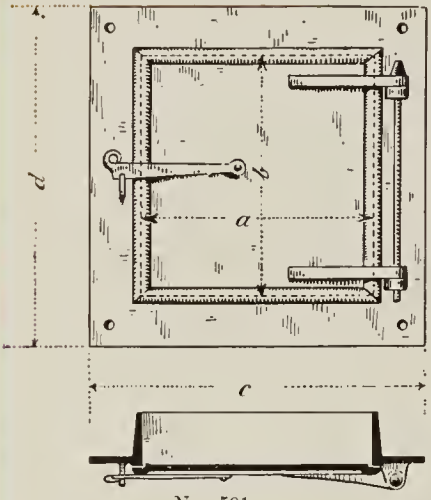


Fig. 97. Stable Gutter.

CLEAN-OUT DOORS



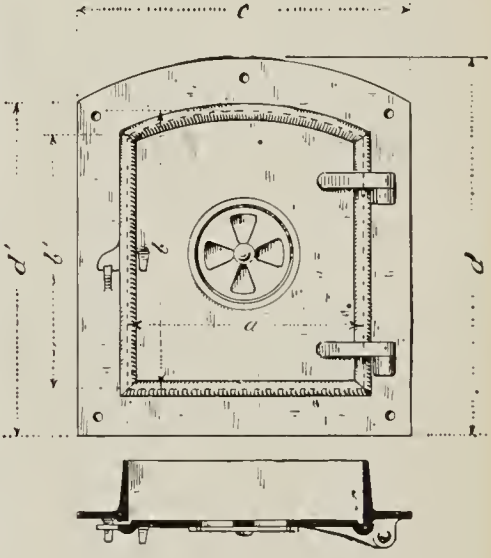
No. 501

STOCK SIZES

Nominal Size	*a*	*b*	*c*	*d*
6 x 6	6	6	10	10
8 x 8	8	8	13	13
10 x 12	10	12	15	17
12 x 16	12	16	17	21
16 x 16	16	16	21	21
18 x 24	18	24	24	30
20 x 20	20	20	26	26
20 x 24	20	24	27	31
24 x 24	24	24	31	31
30 x 30	30	30	38	38
24 x 36	24	36	32	44

STOCK SIZES

Nominal Size	*a*	*b*	*b′*	*c*	*d*	*d′*
13 x 20	13	20	18	19	26	23
16 x 18	16	18	15½	20½	23	19
16 x 24	16	24	22	24	32	28½
18 x 18	18	18	15½	22	22	18½
24 x 14	24	14	12	30	20	17
24 x 16	24	16	14	34	27	22
27 x 47	27	47	43	37	54	49
30 x 52	30	52	48	38	60	54



No. 502

Above lists show sizes of patterns which we have in stock.
We carry the following sizes of No. 501 for immediate shipment: 6 x 6, 8 x 8, 10 x 12, 12 x 16, 16 x 16.

SPECIAL SIZES TO ORDER

DRINKING FOUNTAIN

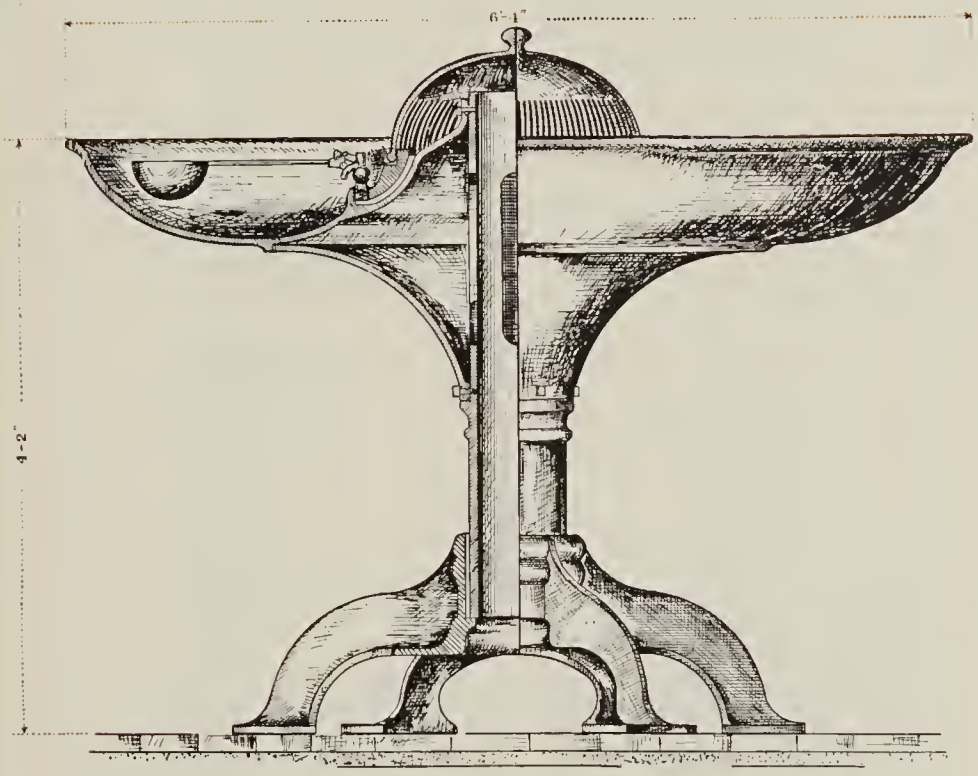


Fig. 98

A large number of these fountains are in use in St. Paul and other towns and cities in the Northwest. They are moulded in graceful lines and are substantial and permanent. To prevent the waste of water they are supplied with an automatic cut-off which may be omitted when desired.

We will be pleased to furnish further information with larger cut to parties desiring such a fountain, and can guarantee it to be neat, graceful and permanent.

HYDRANT AND LAMP-POST

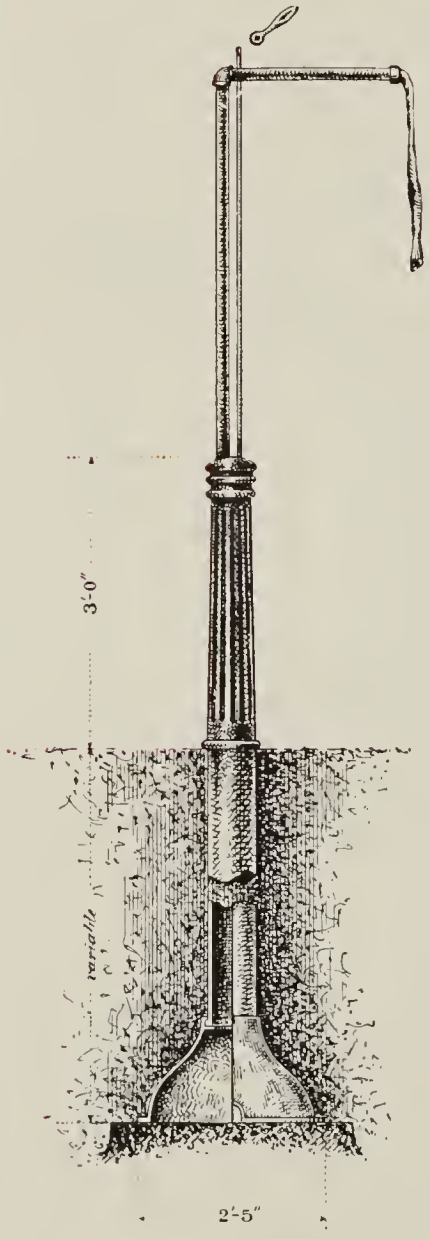


Fig. 99
Sprinkler Hydrant

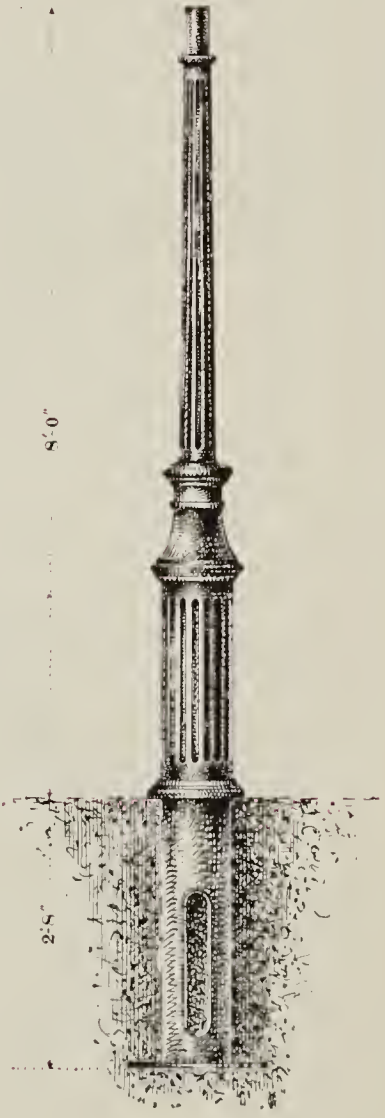


Fig. 100
Lamp-post

LAMP POSTS

FOR PUBLIC BUILDINGS

Fig. 103.
Height 5' 0"
To Base of Small Globes

Fig. 102.
Height 7' 0"
To Base of Globe

Fig. 101.
Height 5' 6"
To Base of Globe

ORNAMENTAL STREET POSTS

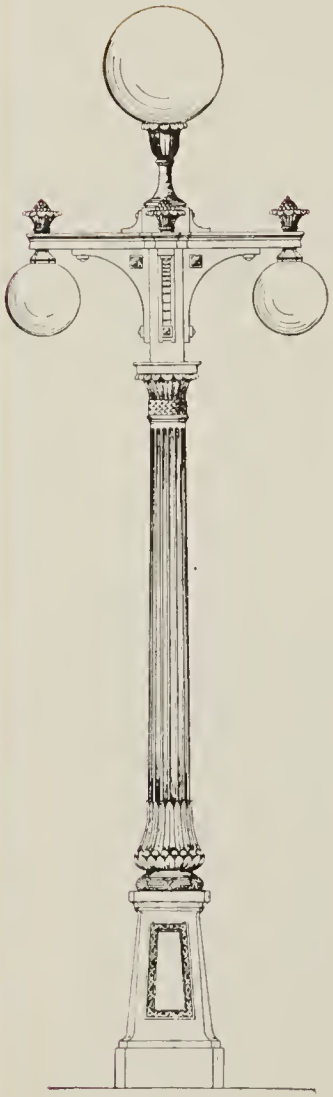


Fig. 104.

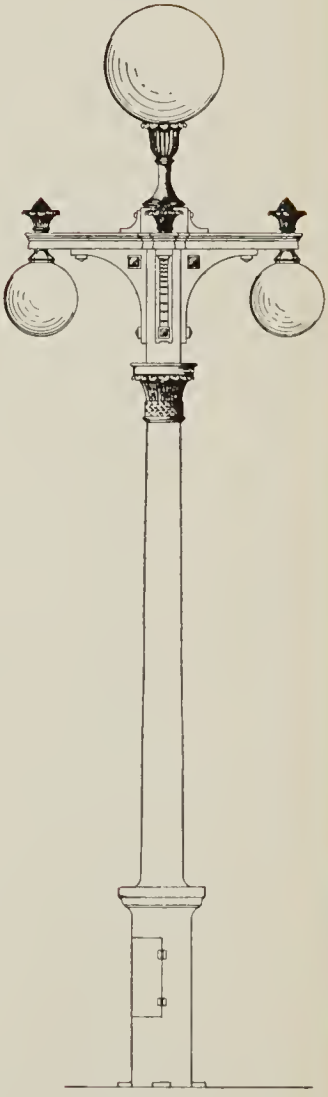


Fig. 105.

These posts can be furnished for either 3 or 5 lights.
Posts of special design at very low prices.

Prices on Application.

AUTOMOBILE TURNTABLE

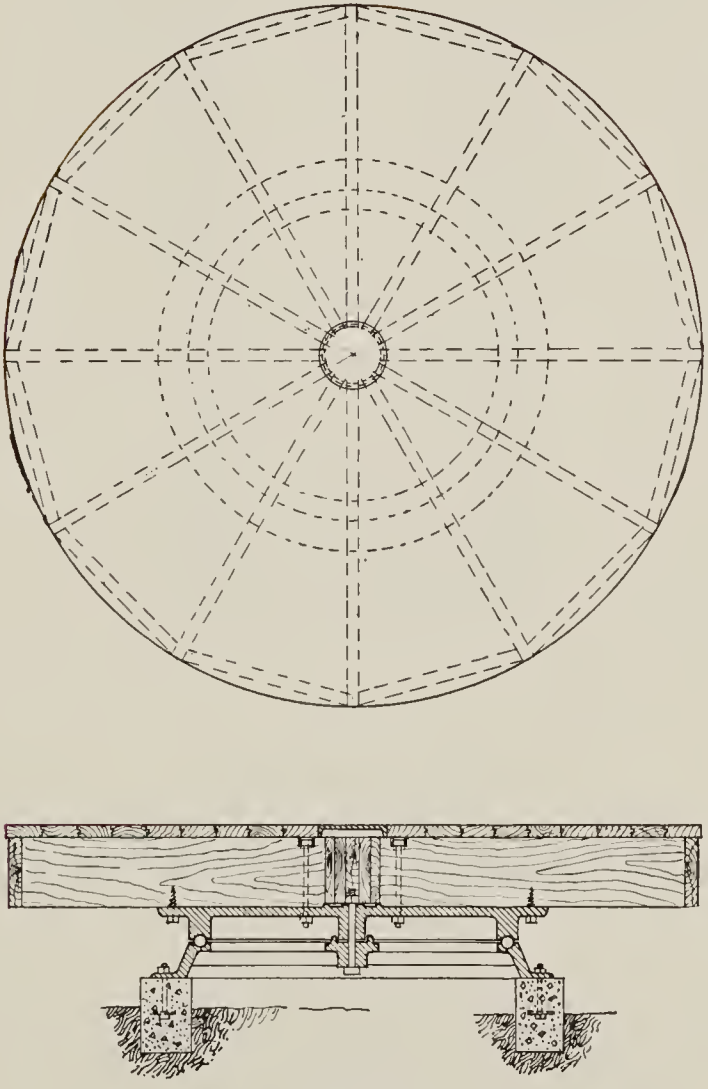


Fig. 106.

The entire support is the ball bearing center which eliminates friction at the sides and allows the table to turn easily.

There are no parts to lose and no attention is required after setting.

Made 10 or 12 feet in diameter.

Will carry the heaviest cars.

REFUSE BURNER

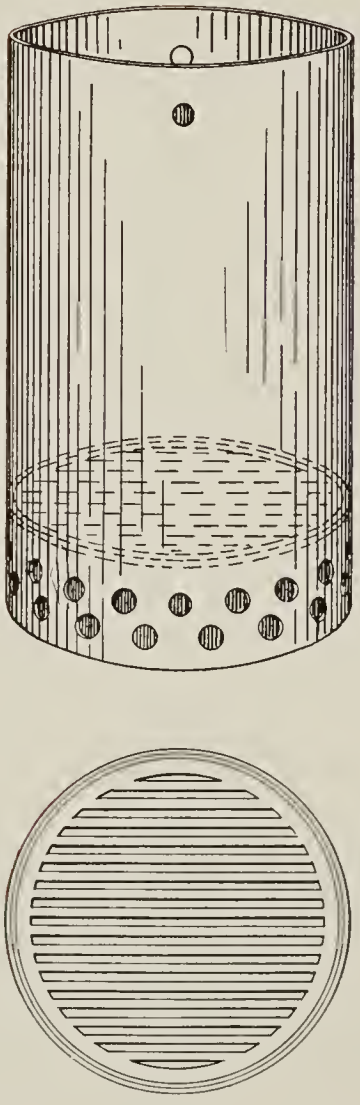


Fig. 107.

Standard Size 18 inches diameter, 3 feet high.

Our Refuse Burner is neat and inconspicuous. Made of steel firmly riveted it will last a lifetime. It is provided with a dump-grate allowing the ashes to be removed when necessary.

Prices on application.

STANDARD SASH WEIGHTS

Length in Inches	Weight in pounds	Length in Inches	Weight in pounds	Length in Inches	Weight in pounds
6	3	**14**	8	**21¾**	13
6⅞	3½	**14¾**	8½	**23½**	14
7⅝	4	**15½**	9	**25**	15
8½	4½	**16¼**	9½	**26¼**	16
9¼	5	**17**	10	**27½**	17
10	5½	**17¾**	10½	**29**	18
10¾	6	**18½**	11	**30½**	19
11½	6½	**19¼**	11½	**32**	20
12¼	7	**20**	12	.....	.....
13¼	7½	**20¾**	12½	.....	.....

All of the above weights are 1¾ inches in diameter and are carried in stock. Heavier weights of any size, round or square, to order.

WEIGHTS OF LEAD TO ORDER

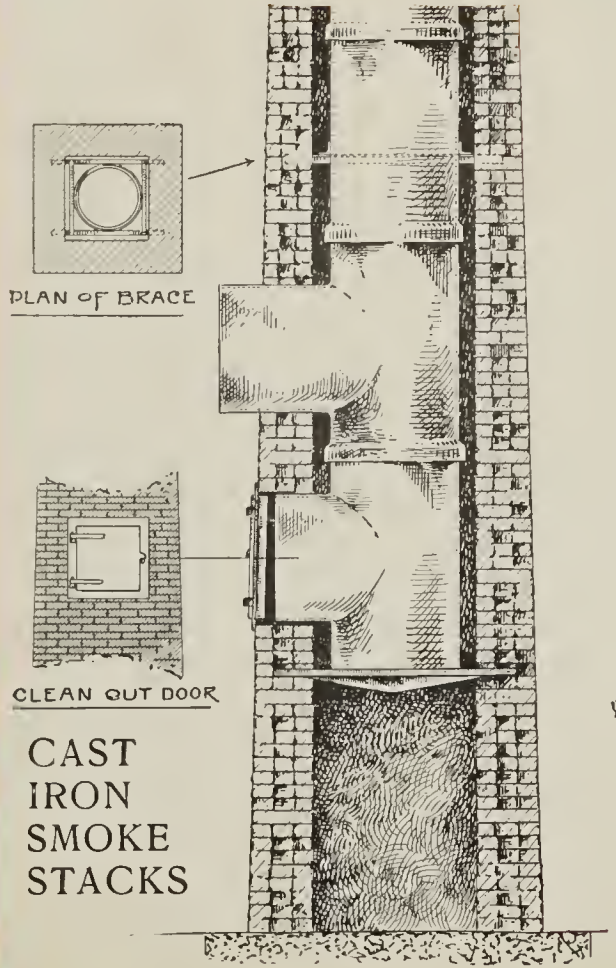
GRATE BARS

Fig. 108

Grate bars this type in all standard sizes.

Fig. 109

"Tupper" grate bars any size from 16 inches to 5 feet 6 inches.



CAST IRON SMOKE STACKS

Fig. 110

BOILER FRONTS

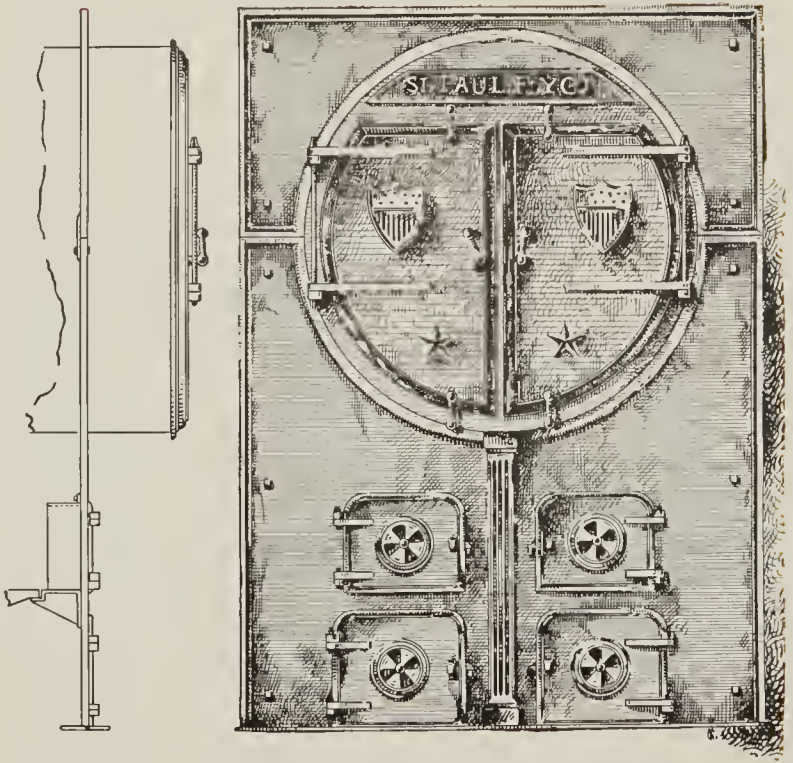
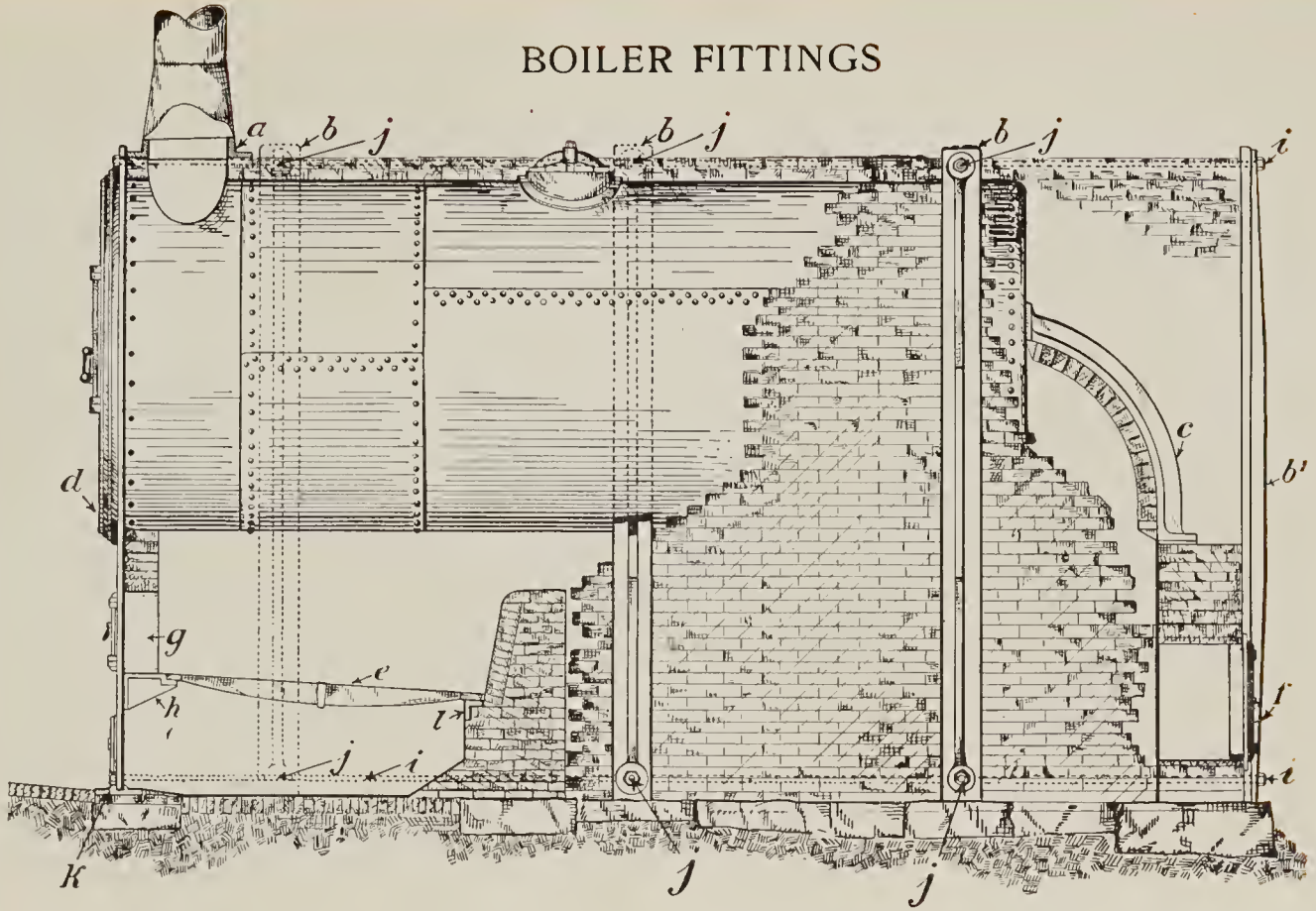


Fig. 111

We have both the Flush and Extension Fronts for all standard sizes. Further information and prices on application.

BOILER FITTINGS



a—Damper Plate
b b[1]—Buck Stays
c—Arch Bars
d—Front
e—Grate Bar
f—Clean-out Door
g—Lining for Fire Door
h—Front Grate Bar Rest
i—Longitudinal Rods
j—Cross Rods
k—Foot Plate
l—Rear Grate Bar Rest

ST. PAUL FOUNDRY CO.

MANUFACTURERS OF

CAST IRON FLOOR PLATES
CEMENT DIES
PULLEYS
PILLOW BLOCKS
GEARS, Etc., Etc.
SPECIAL GAS AND WATER PIPE CONNECTIONS

CASTINGS

FOR

LOCOMOTIVES AND CARS
ELECTRIC RAILWAYS
MACHINERY
CYLINDERS
ROOFS AND BRIDGES

General Machine Work, including the manufacture of Medium Weight and Heavy Machinery.

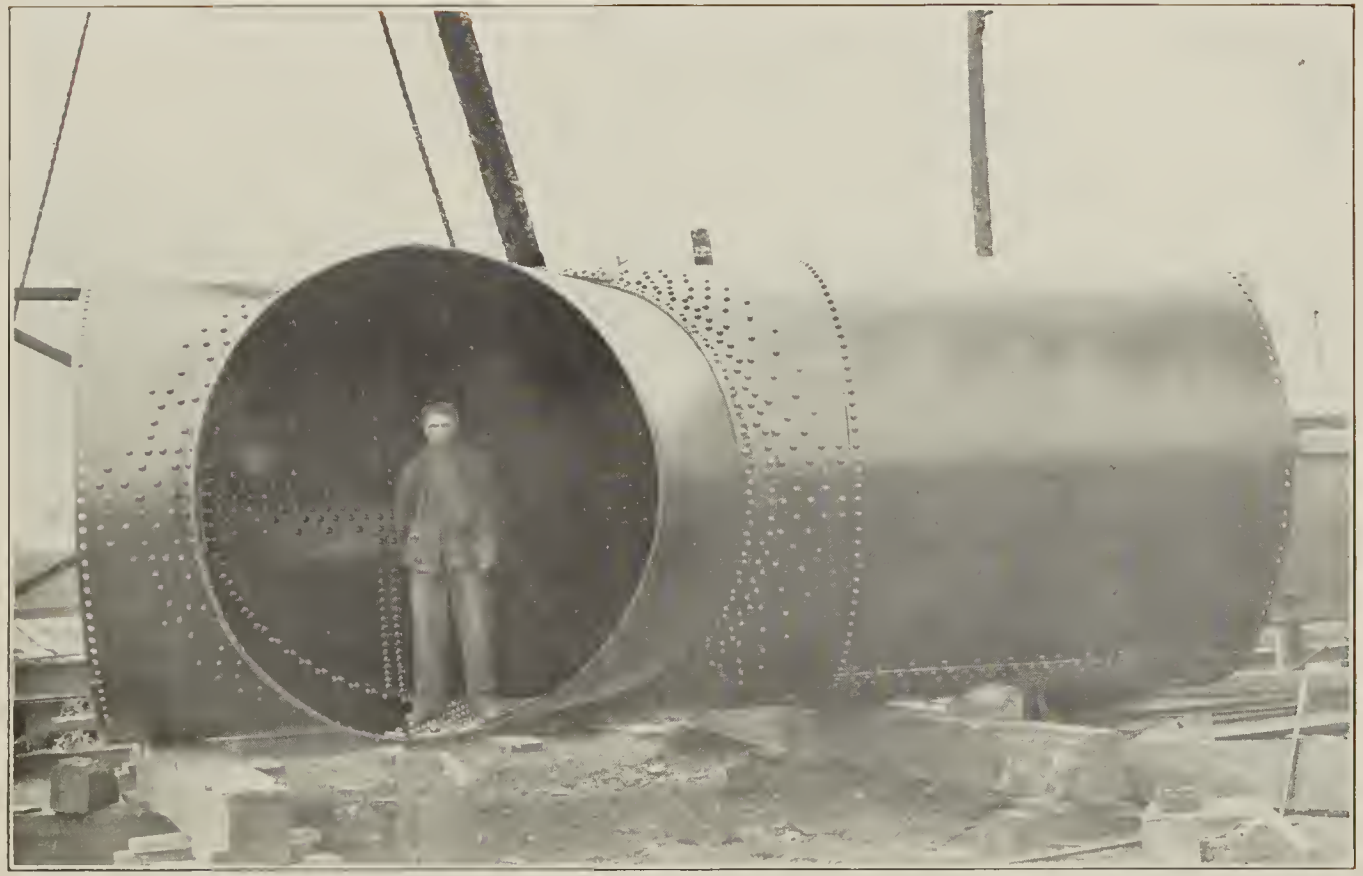
Blacksmith Work.

Medium Weight and Heavy Forgings, Rods, Bolts, Architectural Wrought Iron.

MAIN STAIR Y. M. C. A. BUILDING, ST. PAUL

C. H. JOHNSTON, Architect

All structural steel and ornamental iron furnished and erected by St. Paul Foundry Co.



PENTSTOCK FOR G. N. RY., LEAVENWORTH, WASH.

1000 feet long 8 feet in diameter $\frac{9}{16}$ inch plate. Constructed and erected by St. Paul Foundry Co.

KING STREET STATION FOR G. N. and N. P. RY., SEATTLE, WASH.

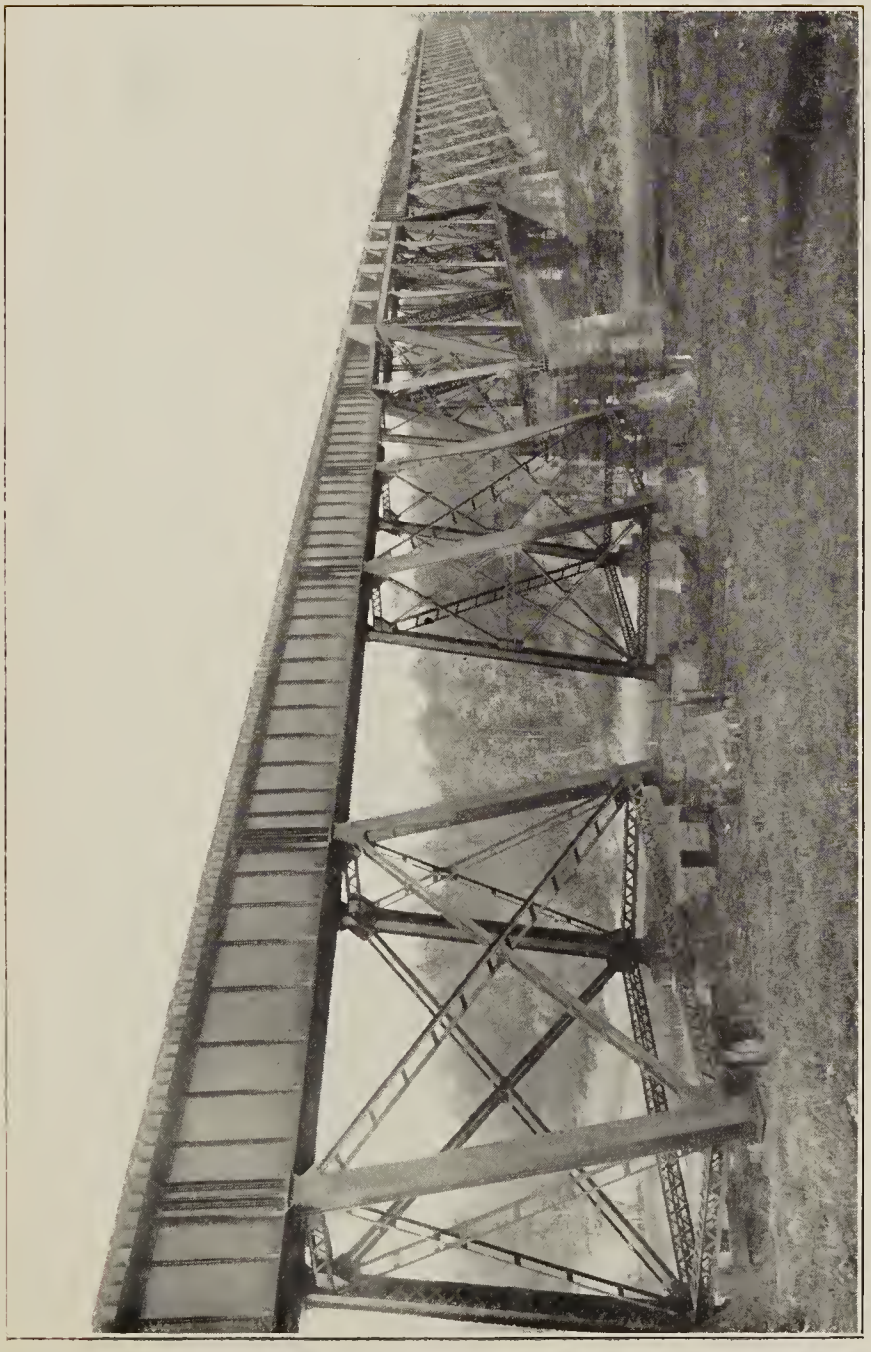
REED & STEM, Architects

1000 Tons. Constructed and Erected by St. Paul Foundry Co.

WAREHOUSE FOR FARWELL, OZMUN, KIRK & CO., ST. PAUL

LOUIS LOCKWOOD, Architect

1000 Tons. Designed, Constructed and Erected by St. Paul Foundry Co.



R. R. BRIDGE FOR G. N. RY.

2000 Tons. Constructed by St. Paul Foundry Co.

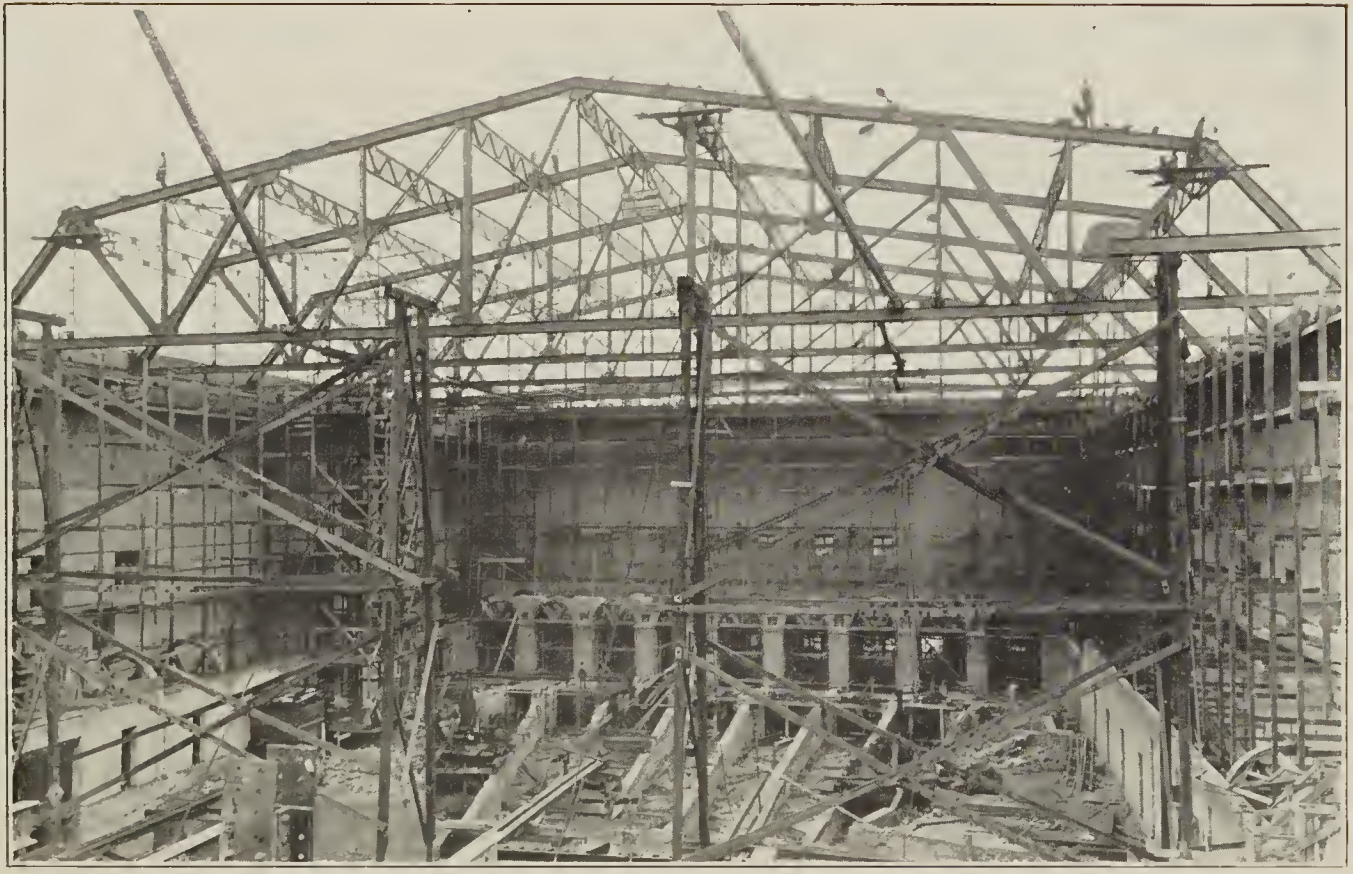
200 FOOT HIGHWAY BRIDGE NEAR SPOKANE, WASH.

Designed and Constructed by St. Paul Foundry Co.

Diameter:
16′ 9″ at base,
12′ 9″ at top.
Height 60′

Constructed and Erected by St. Paul Foundry Co.

STEEL STACK, POWER HOUSE SEATTLE ELECTRIC CO., SEATTLE, WASH.



ROOF TRUSSES, AUDITORIUM, ST. PAUL

REED & STEM, Architects

1200 Tons of Structural Steel. Constructed and Erected by St. Paul Foundry Co.

INDEX

A

	PAGE
Anchors for I-Beams	47
Angles, Areas of	16
" In Compression	72-75
" Properties of	41-45
" Safe Loads for	33-35
" Standard, Cuts of	12-13
" Struts Safe Loads for	72-75
" Weights of	17
Area Gratings	177
Areas of Square and Round Rods	88-89
Automobile Turntables	207

B

Balcony Rails	188-189
Bar-lock Sidewalk Lights	194
Bases for Cast Iron Columns	154-156
Beams, Bending Moments for	26
" Deflection of	26
" Formulæ for Flexure of	37
" Supporting Brick Walls	52
" Wooden Safe Loads for	94
Bearing Plates for I-Beams and Channels	24
Bending Moments for Beams	26
Bethlehem Sections	94-140
" Columns, Properties and Dimensions	106-113
" Columns, Safe Loads for	126-133
" I-Beams as Columns, Safe Loads for	122-125
" I-Beams, Detail Dimensions and Guages	138-140
" I-Beams, Safe Loads for	114-121
" I-Beams, Standard Connections for	134-137
" I-Beams, Properties of	102-105
Boiler Fittings	211
Boiler Fronts	210
Bolts, Cuts of	80
Bolts, Standard Dimensions of	84
Bolts, Weights of	82
Brackets, Ornamental Wrought Iron	190
Brick Walls, Support of	52
Brick Walls, Weight of	52
Building Laws of Various Cities	92-93
Building Materials, Weight of	91

C

Capitals for Cast Iron Columns	159-164
Cast Iron Column Bases	154
" " Columns, Safe Loads for	144-151
" " Lintels, Safe Loads for	153
" " Plates, Weights of	152
Catch Basin Covers	200

INDEX—Continued

	PAGE
Ceilings, Porous Tile, Weights of	51
Channels, Cuts of	10-11
" Columns, Safe Loads for	61-64
" Dimensions and Guages	22
" Properties of	40
" Safe Loads for	31, 32
Clean-out Doors	202
Coal Hole Covers	196-197
Column Caps, Cuts of	159-164
Columns Bethlehem, Properties and Dimensions of	106-113
" Bethlehem, Safe Loads for	126-133
" Cast Iron, Round Ornamental	157-158
" Cast Iron, Square Ornamental	165-171
" Cast Iron Safe Loads and Weights	144-149
" Gas Pipe Safe Loads and Weights	150
" Latticed Channel, Safe Loads for	60
" Latticed Channel, Size of Lacing for	60
" Plate and Channel, Safe Loads for	61-64
" Standard I-Beam, Safe Loads for	65
" Steel Cuts of	48
" Wooden, Safe Loads for	95
" Z-Bar, Safe Loads for	66-67
Concrete Floors	50
Connection Angles, Standard	23
Connection Angles, Bethlehem	134-137

D

Decimal Equivalents	90
Deflection of Beams	26
Dimensions of Bethlehem I-Beams	100-101-138-140
" of Bethlehem Columns	106-113
" of Plate and Channel Columns	61
" of Standard I-Beams and Channels	22
" of Standard Tees	18
" of Standard Z-Bars	19
Door Bumpers	192
Door Guards	176
Drinking Fountain	203
Duplex Hangers	177

E

Entrance Plates	173

F

Face Plates, Cast Iron	172
Fences, Wrought Iron	192-193
Fire Escapes	186-187
Floors, Wood	49
Floors, Fireproof	50
Floor Loads	50
Formulæ for Flexure of Beams	37
Furring, Weight of	51

G

Gas Pipe Columns, Safe Loads for	150
Gas Pipe, Dimensions of	150
Gates, Wrought Iron	192
Girders I-Beam Box, Safe Loads for	54-55
Girders Plate, Safe Loads for	56-59

INDEX—Continued

PAGE
Guages of Bethlehem I-Beams....138-140
Guages of Standard I-Beams.... 22
Grate Bars.... 209
Gutters, Cast Iron.... 201

H

Hydrant, for Street Sprinkler.... 204

I

I-Beam Box Girders, Safe Loads for.... 54-55
I-Beams, Bethlehem, as coluuums, Safe Loads for....122-125
" Bethlehem, Dimensions and Guages....138-140
" Bethlehem, Properties of....102-105
" Bethlehem, Safe Loads for....114-121
" Bethlehem, Weights and Dimensions of....100-101
" Standard, Anchors for.... 47
" Standard, as Columns.... 24
" Standard, Bearing Plates for.... 23
" Standard, Connections for.... 23
" Standard, Cuts of....6-7-8-9
" Standard, Dimensions and Guages.... 22
" Standard, Properties of.... 38-39
" Standard, Safe Loads for....28-29-30
" Standard, Typical Details.... 46

L

Lacing Size of, for Channel Columns.... 60
Lamp Posts....204-205-206
Laws, Building of Various Cities.... 92-93
Lintels, Cast Iron Safe Loads for.... 153
Lintels, Typical Details.... 46
Loads—See Safe Loads.

M

Majestic Coal Chute.... 195
Manhole Covers.... 198
Manufacturers' Standard Specifications.... 97
Mensuration 98
Minimum Spans for Standard Connections....134-135

N

Nails and Spikes.... 96
Newel Posts, Cuts of....179-181
Nuts, Standard Dimensions for.... 84

P

Partitions, Weights of.... 51
Pillars—See Columns.
Pilasters—See Columns.
Plates, Weights of.... 20
Plate and Channel Columns, Safe Loads for.... 61-64
Posts—See Columns.
Post Caps.... 156

INDEX—Continued

PAGE

Properties of Bethlehem Columns....106-113
" of Bethlehem I-Beams....102-105
" of Standard Angles.... 41-45
" of Standard Channels.... 40
" of Standard I-Beams.... 38-39

Q

Quills, Cast Iron.... 156

R

Railings for Areas.... 178
Railings for Balconies....188-189
Railings for Stairs....182-184
Refuse Burner.... 208
Rivets, Length of, for Various Grips.... 78
Rivets, Shearing and Bearing Values.... 76-77
Rivets, Weight of.... 81
Rods, Square and Round, Weights and Area of.... 88-89
Rods, Tensile Strength of.... 79
Rods, Upsets for.... 79
Roofs, Weight of.... 51-68
Roof Trusses.... 68-71
Ropes, Wire and Manila, Strength of.... 96

S

Safe Loads for Bethlehem Columns....126-133
" " for Bethlehem I-Beams....114-121
" " for Bethlehem I-Beams as Columns....122-125
" " for Cast Iron Columns....144-149
" " for Cast Iron Lintels.... 153
" " for Gas Pipe Columns.... 150
" " for I-Beam Box Girders.... 54-55
" " for Latticed Channel Columns.... 60
" " for Park and Channel Columns.... 61-64
" " for Plate Girders.... 56-59
" " for Standard Angles.... 33
" " for Standard Channels.... 31-32
" " for Standard I-Beams.... 28-30
" " for Standard I-Beams as Coluumns.... 65
" " for standard Tees.... 36
" " for Wooden Beams.... 94
" " for Wooden Columns.... 96
" " for Z-Bar Columns.... 66-67
Sash Bar....174-175
Sash Weights.... 209
Screws, Wood.... 96
Screw Threads, Standard.... 84
Separators for Bethlehem I-Beams....134-135
Separators for Bethlehem I-Beams.... 25
Sewer Catch Basins.... 199
Sewer Grates.... 199
Sheets, Weights of.... 21
Sidewalk Covers.... 200
Sidewalk Doors.... 195
Sidewalk Lights.... 194
Specifications, Manufacturers Standard.... 97
Spikes and Nails.... 96
Sprinkler Hydrants.... 204
Stacks Cast Iron.... 210

INDEX—Continued

PAGE

Stairs, Outside 185
Stair Railing 182-183
Standard Beam Connections to Cast Iron Columns 155
Standard Connection Angles for Bethlehem I-Beams 136-137
Standard Connection Angles for Standard I-Beams 23
Stirrups 177
Stresses Allowed by Various Building Laws 92-93

T

Tees, Safe Loads for 36
Tees, Standard, Cuts of 14
Tees, Standard Weights and Dimensions of 18
Tensile Strength of Rods 79
Tile Floor Construction 50
Trench Cover 201
Trusses, Notes on 68
Trusses, Steel Coefficients for 71
Trusses, Wood Coefficients for 69
Turnbuckles, Dimensions and Weights of 83
Turn Table for Automobiles 207

U

Upset Screw Ends 86-87

W

Washers, Dimensions and Weights 85
Weights of Angles 17
" of Bolts 82
" of Brick Walls 52
" of Building Materials 91
" of Cast Iron Columns 114-151
" of Cast Iron Column Bases 154
" of Cast Iron Plates 152
" of Fireproof Material 51
" of Plates, Steel 20
" of Rivets and Round Head Bolts 81
" of Roofing 68
" of Separators, Bethlehem 134-135
" of Separators, Standard 25
" of Sheets, Steel 21
" of Square and Round Rods 88-89
" of Tees 18
" of Turnbuckles 83
" of Upset Rods 86-87
" of Wood Floors 49
" of Z-Bars 19
Window Guards 191
Wire Rope, Strength of 96
Wooden Beams, Safe Loads for 94
Wooden Columns, Safe Loads for 95
Wood Floors, Notes on 49

Z

Z-Bar Columns, Safe Loads for 66-67
Z-Bars, Standard, Cuts of 15
Z-Bars, Standard, Weights and Dimensions of 19

THE PIONEER
COMPANY
SAINT PAUL
1940